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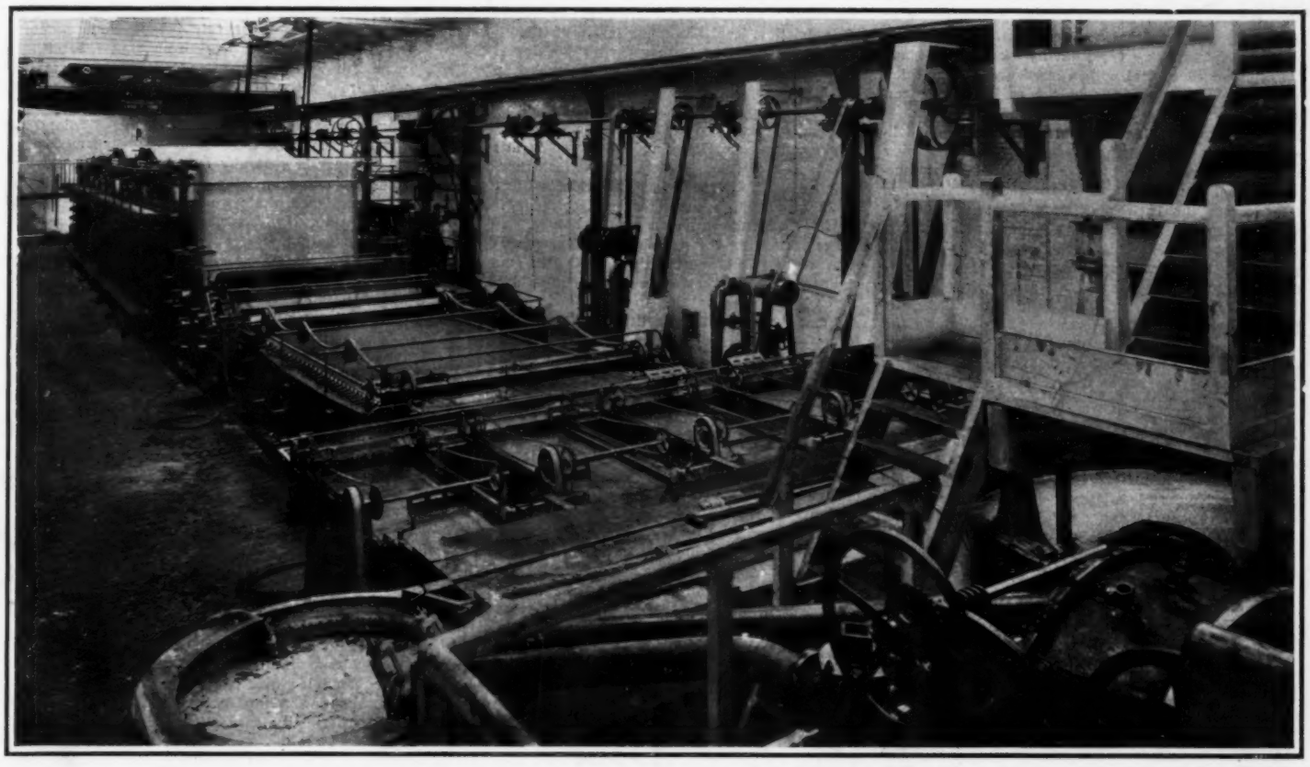
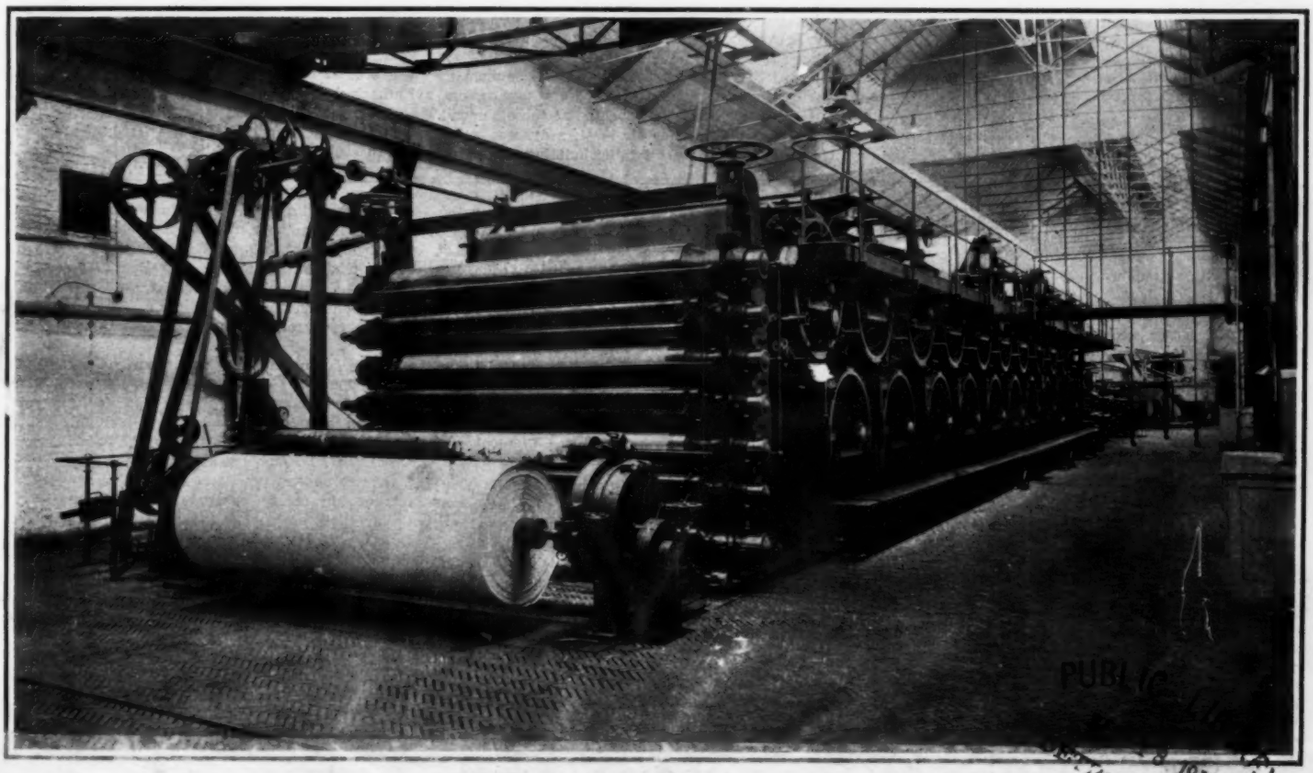


VIEW FROM REFINING ENGINE OF THE DAILY TELEGRAPH PAPER-MAKING MACHINE



THE DAILY TELEGRAPH PAPER-MAKING MACHINE. VIEW FROM DRY END

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A LARGE PAPER-MAKING MACHINE

A Large Paper-Making Machine

A London Newspaper Installation

By F. C. Coleman

A LARGE installation of paper-making machinery has recently been introduced by the proprietors of the Daily Telegraph of London at their paper mills at Dartford-on-Thames.

One of the most interesting features in the design of this plant is the incorporation of a refining engine, making it a component part of the paper-making machine. This refiner is introduced between the high stuff chest and the mixing box, the quantity of pulp being regulated before it enters the last, and is of the "Sciennes" new type, having specially designed disks, arranged to deal with a large quantity of thick pulp. The case is made in halves, so that access can easily be had to the interior. The adjusting gear is of a new type, making adjustment accurate and delicate. The refiner, which is capable of passing over one ton of dry paper per hour, and which, on occasion, has passed this quantity without difficulty, is driven from the back shafting engine; and as the exhaust steam is used for drying the paper, it is apparent that the refiner is driven free of all cost for power. From the mixing box, which is of special design, the pulp passes over the sand tables to five flat strainers, each with brass vats, having specially designed inlet and outlet channels, which simplify the spouting and insure cleanliness. Each strainer is also fitted with improved scraper gear for keeping the surface of the plates clean, the refuse removed from the plates being carried along a channel to an ordinary jog auxiliary strainer. The pulp is fed from the strainers to the wire frame through a breast box, designed by Mr. Greig, the manager of the Dartford mills. The wire frame carries a wire 134 inches wide by 60 feet long, and is arranged so that the breast roll can be raised to any desired extent should this be considered necessary, while the breast roll is of special make to insure lightness and rigidity. The deckle has large pulleys and stiff deep slices.

The frames are also arranged with special scrapers to keep the inside of the straps dry and to prevent splashing. Constructed of aluminium and carried on strong brass bars, the vacuum boxes are all arranged so that a box can be taken out when the machine is running without difficulty. The couch rolls are of brass, the top roll being carried in special lever arm brackets, and the couch can be conveniently altered. The guardboard is of the swiveling type, while the spray pipe is connected up by means of brass connections to prevent the use of the usual unsightly rubber hose pipe.

The press rolls and felt washing rolls are of brass and iron, and the wet felt rolls are of copper. Of a specially neat, open-faced design, the press roll brackets are arranged with levers and weights for giving pressure, and the leading rolls at the wet end are of the "Sciennes" patent type, arranged to relieve the paper of all strain. These rolls run slightly faster than required when the paper breaks, thus running up the slack quickly when the end is put over, and are of great assistance to the attendants leading paper over wide, fast-running machines.

There are twenty drying cylinders, each of 16 feet circumference, made of very fine close iron, ground and polished like chilled rolls, which are driven by means of machine-cut spur wheels, and are carried in special roller bearings, which reduce friction to a minimum. They are so balanced and run with so little friction, that, although each of them weighs over five tons, it can be moved with one finger. There are four felt-drying cylinders, also carried in roller bearings.

The steam and exhaust connections are of the "Sciennes" patent type, fitted at the back of the machine, and each cylinder and felt-dryer is fitted with special water-lifting buckets and water traps. Each cylinder and felt-dryer is also provided with a patent steam trap, which separates each cylinder from its neighbor and allows only water to escape.

The frame for the cylinders is of massive description, arranged to carry them with the maximum rigidity at the highest speeds, and finished to a degree which leaves nothing to be desired.

Along the front of the cylinders there are two platforms—the under one for leading the paper along the cylinders, and the upper to enable the attendant to have access to the various rolls and bearings overhead. The calender is fitted with chilled rolls carried in open-faced frames and ring-oiling bearings, and each roll is fitted with a doctor and a special air-blast arrangement to cool the paper. The reeling-up gear enables heavy reels to be turned round and changed without any exertion on the part of the attendant. This gear saves labor and at the same time it winds very hard, heavy webs.

The machine is driven by means of two compound, high-speed engines, made by Messrs. Ashworth & Parker, the engine for the machine being fitted with a rope flywheel and driving the various parts by means of the "Sciennes" patent expanding rope pulley gearing with machine-cut wheels. This gear, which runs very smoothly, is driven by one continuous rope. The latter is automatically stretched by means of a carriage and a deadweight, so that the tension is always uniform.

The engine and gearing are arranged to run the machine up to a high speed should this ever be required. A platform extends the full length of the machine at the back, enabling the attendant to get any bearing without difficulty or danger, all the wheels being efficiently covered by guards. The back shafting engine runs at a constant speed, and drives a shaft which extends from end to end of the machine house, driving the refiner, stuff chests, pumps, etc., at one end, and the reeling machine at the other end. It also drives the fans for air blast, a dynamo which provides the electric light for the building, the power for the traveling crane, the fans, and also for some small outlying plant in the mill. This arrangement of taking power from the back shafting engine was introduced on this machine for the first time, and the power available from this source is more than sufficient for the machines named above, being obtained quite free of all cost, as the machine, under all circumstances, is able to consume the steam in drying the paper. There is never any waste steam to blow off, and the result of this arrangement, combined with the excellent services throughout the mill, has brought the coal consumption down to an exceedingly low figure per ton of paper, and this too without the machine or the mill being pushed to produce anything other than an ordinary amount. While it will be recognized that a reduced coal consumption per ton of paper is generally only to be obtained with a large production, yet the arrangements in this mill are so designed that a minimum coal consumption can be attained without any endeavor to produce a maximum output.

The stuff pumps are of the plunger type, of very heavy make, and are designed specially to work under a high head, while the backwater pump is of the "Sciennes" special centrifugal type, all of brass, with copper piping. The vacuum pumps have four plungers, all arranged to be driven by one belt, connected up with copper piping. The excess-water pump is of the centrifugal type, so arranged that it takes all the pulp from below the wire and delivers it to a specially constructed tank in the beater house, thus insuring no waste and no labor in connection with keeping the pit below the wire frame clean.

The accompanying views of this machine will give some idea of its size and proportion. It is fitted up in a spacious building, of ample width and length, and right overhead is a 7-ton electric crane (operated from the floor), which is capable of handling any part of the machine. The re-reeling machine is placed at the dry end of the machine. It was designed specially to make very hard, evenly wound webs, and to run at a high speed. The reel of paper from the paper-making machine is put in special brackets, the paper being led over a leading roll, which operates an automatic brake. This brake maintains a perfectly uniform tension on the web from start to finish of the reel. It then passes over a measuring roll, attached to a counter; then from the slitting knives and over leading rolls to the winding-up drum.

The reeler arms are arranged to discharge the webs on to the bogies, and ample freedom is given to the attendant to get at all the webs without difficulty. This machinery was designed, manufactured, and erected by Messrs. Bertrams, Limited, of the St. Katherine's Works, Edinburgh, in accordance with the requirements of Mr. Greig, the manager of the paper-making department at Dartford, the firm acting in conjunction with him.

The Manufacture of Carbon Electrodes

IN the Journ. Ind. and Engin. Chem., Mr. G. A. Roush writes on the manufacture of carbon electrodes.

The materials used are coke, hard and soft pitch, coal tar, and petroleum oil ("summer oil"); part of the coke may, however, be replaced by lampblack if electrodes of better wearing properties are required. The coke used is petroleum coke, containing 0.02 to 0.06 per cent of ash; this is crushed and then freed from volatile matter in firebrick retorts (cost of calcination about £1 per ton). The calcined coke is ground to dust of varying degrees of fineness, according to the kind of electrode required. For producing the finest dust a Raymond impact pulverizer is used, in which a grinding wheel, suspended from one end of a rotating arm, is forced by centrifugal action against a heavy ring. The crushed material is caught by an ascending current of air from a fan, and the fineness of the dust collected is controlled by regulating the speed of the fan, the heavier particles being allowed to fall back into the pulverizer. With this machine it is possible to obtain without bolting dust of such fineness that 98 per cent will pass a 100-mesh sieve, and 92 per cent will pass a 200-mesh sieve. Coarser dusts are produced either in the same machine or in the ordinary burr mill, with or without bolting. The hard pitch is crushed to ½-inch size. The composition of some of the mixtures commonly used is as follows: (1) For ordinary electrodes: coke, 325 pounds; hard pitch, 110 pounds; oil, 1 gallon. (2) For a somewhat finer dust or a pitch of higher melting-point: coke, 325 pounds; hard pitch, 115 pounds; oil, 2 gallons. (3) For a coarse dust: coke, 325 pounds; hard pitch, 40 pounds; melted soft pitch, .. gallons; oil, 1 gallon. (4) For a "carbon" to stand heat and wear and not to be used as electrode: coke, 325 pounds; lampblack, 20 pounds; hard pitch, 30 pounds; tar, 10 gallons. The ingredients are mixed for about 20 minutes in steam-jacketed kettles provided with revolving blades. The hot mixture, having a temperature of 265 deg. to 275 deg. F., is placed in heavy cast-iron hoops, and by means of a hydraulic press is compressed into cheeses or plugs about 6 inches thick and of the same diameter as the opening in the press in which the carbons are subsequently formed. The plugs are allowed to cool to 200 deg. to 240 deg F., and then forced through dies which are usually about 3 to 5 per cent larger than the desired diameter of the finished carbons. The pressure used must not be too high, otherwise the material expands so rapidly on emerging from the die that the "carbon" splits radially from end to end. The baking of the electrodes occupies from 10 to 14 days, the temperature being increased steadily, finally to 1,020 deg. The furnace is allowed to cool for four or five days before being opened. The finished "carbons" should have a resistance of about 0.0016 ohm per 1-inch cube, and be capable of conducting a current of 25 amperes per square inch of cross section. They are also tested for apparent density, real density, and content of ash. In the case of ordinary electrodes the apparent density varies from 1.55 to 1.70, the real density from 1.95 to 2.05, and the ash content from 0.1 to 0.3 per cent. Electrodes of amorphous carbon to be converted into graphite by the Acheson process are prepared in a similar manner, the composition of the mixture used being: coke, 325 pounds; hard pitch, 103 pounds; soft pitch, ½ gallon; oil, 1 gallon; iron oxide, 5 pounds. The finished "carbon" ready for graphitization should contain about 1.5 per cent of ash and have a real density of at least 2.

Under favorable conditions, states a contemporary, the exhaust from a gas engine will, if passed through a suitable exhaust gas boiler, evaporate from two to two and a half pounds of steam per brake horsepower hour. Where the steam can be used this marks a substantial economy, and one would expect such boilers to be very popular. As a matter af fact, very few are in use. One reason is, undoubtedly, that these boilers are subject to serious corrosion in many cases, particularly where, as frequently occurs, cold water is used for feeding the boiler. If, in addition, the boiler is shut down at week-ends, it may be very cold when starting and will sweat. The exhaust gases being corrosive—especially if producer-gas is used—a dilute acid 's formed which has serious effects on the plates. A method of partially overcoming this corrosion, which is not often used, consists in feeding the boiler with water from the jackets. This water is, perhaps, at 120 deg., and its temperature prevents sweating. On the other hand, there is no hot water when the engine first starts after a prolonged stoppage, and unless the boiler can wait half an hour or so, some artificial means of heating the boiler should then be adopted.

Locomotive Power

How Professor Dalby Calculates It

THE excellent address prepared by Prof. Dalby, as president of Section G, at the last meeting of the British Association, has not received the attention it deserved. The audience was scanty, although the subject was attractive—"British Railways: Some Facts and a Few Problems." The address as a whole was not delivered; but Prof. Dalby talked about it, and received a vote of thanks. There was no discussion, although it presented many points for argument and careful consideration. Its interest lies principally in the comparison drawn between railway working in the present day and in 1840. A dozen examples might be picked out in a few minutes. Thus, for instance, Prof. Dalby tells us that the gross receipts of the London and North-Western Railway in 1908 were twenty-two and a half times as much as those of the London and Birmingham Railway in 1840, and that the track mileage open was about twenty-two times as great. The money earned per mile of track open is thus practically the same after a lapse of seventy years. To earn the same amount per mile of track open, however, the trains of the London and North-Western Railway had in 1908 to run 68.3 times the number of train miles that the trains of the London and Birmingham Railway ran in 1840. That is to say, in order to earn a sovereign a London and North-Western train has now to run three times the distance which it was necessary for a London and Birmingham train to run to earn the same amount.

The most interesting portion, perhaps, of the address concerns the power exerted by locomotive engines in hauling fast trains. Here Prof. Dalby entered on highly debatable ground. He calculates the power in terms of tons of total load, including engine and tender, speed, and train resistance. He takes the Scotch express—Euston to Edinburgh—and he reduces his calculations to the form of a diagram. Typical trains, he tells us, weighed in 1864, 1885, and 1903, respectively, 100 tons, 250 tons, and 450 tons. The average speed in 1864 was 40 miles per hour, in 1885, 45 miles, and in 1903 about 52 miles per hour. The engine powers were 100, 400, and 1,000 horse. Precisely what the word "power" means we are not certain, but we gather that it is not the indicated power, but that obtained by multiplying the weight by the resistance, and the velocity in feet per minute, divided by 33,000, which gives a result less than the indicated power by the amount required to overcome the internal friction of the machinery. We do not think that the load was ever so small as 100 tons in 1864. The work was largely done by the "Problem" or "Lady of the Lake" class, with outside cylinders, and 7-foot 6-inch wheels. These engines weighed full about 30 tons, and the tender 18 tons, or, say, 48 tons, which left a very small proportion for the train proper, if the total was only 100 tons. During the "race to the north" in 1888, the train consisted of four coaches weighing 80 tons. But while we believe that Prof. Dalby underestimated the power required in 1864, we are equally certain that he overestimates it for 1903. No locomotive has yet been made for working express trains in this country which will continuously exert 1,000 horse-power between Euston and Edinburgh, or Euston and Carlisle. It must not be forgotten that the power as stated by Prof. Dalby is that required to maintain speed on a level. He bases his calculations on the formula $T = 5\,1/3 + \frac{V^2}{256}$ where T is the tractive effort. Thence he deduces that horse-power developed at the driving wheels is—

$$\text{H. P.} = W\left(\frac{V}{70} + \frac{V^2}{96{,}000}\right)$$

We do not know where Prof. Dalby got his resistance formula. There are, of course, a great number from which to select, but that which he has chosen is much too high. Sinclair deduced from tests made on the New York Central and Hudson River Railroad $R = 2 + \frac{V}{4}$. The Baldwin Locomotive Works use $R = 3 + \frac{V}{6}$. M. Laboriette's French experiments gave $R = 3.25 + \frac{V^2}{281}$. Mr. Deeley, on the Midland, arrived at $R = 3 + \frac{V^2}{290}$. If we take Laboriette, we get for 52 miles an hour 12.3 pounds per ton, and for Deeley 11.8 pounds. Let us take the round number 12 pounds, and we have for 450 tons a gross steady tractive effort on the level of 5,400 pounds. Now 52 miles an hour is 4,576 feet per minute, and $\frac{4{,}576 \times 5{,}400}{33{,}000} = 749$ H.P., or 75 per cent of the power stated by Prof. Dalby—a not unimportant difference. It is well to remember that in the conduct of railway traffic it is the last straw that breaks the camel's back. While a big engine may develop 700 horse-power with ease and economy, to get 1,000 out of it may involve much waste and wear and tear, and the extreme probability that the driver and fireman having nothing in hand will fail to keep time with punctuality.

Prof. Dalby asks the very pertinent question, What is the maximum power that can be obtained from a locomotive within the limits of the construction gage on British railways? This, of course, refers to engines of normal type, and not to such monster double engines as that now being built for South America by the Vulcan Locomotive Company, Newton-le-Willows. He finds no difficulty in answering the question. "While examining the records of a large number of locomotive trials I discovered that if the indicated horse-power be plotted against the rate at which heat energy is transferred across the boiler heating surface the points fall within a straight line region, providing that the regulator is always full open, and that the power is regulated by means of the reversing lever." He has prepared a diagram setting this out graphically. "The diagram indicates that the indicated horse-power is practically proportional to the rate at which heat is transferred across the boiler heating surface, and as this is again proportional to the extent of the heating surface, the limit of economical power is reached when the dimensions of the boiler have reached the limits of the construction gage, the boiler being provided with a fire-grate of such size that, at maximum rate of working, the rate of combustion falls between 70 pounds and 100 pounds of coal per square foot of grate per hour. A boiler of large heating surface may be made with a small grate necessitating a high rate of combustion to obtain the required rate of heat production. Then, although a large power may be obtained, it will not be obtained economically."

We confess that this proposition puzzles us. Ostensibly it quite ignores the way in which the steam is used. The units transmitted produce the same quantity of steam per unit no matter at what rate the transfer proceeds, and the weight of steam is the measure of the power of the locomotive, no matter in what way it is used. But it seems to be obvious that if an engine is taking steam for 80 per cent of its stroke, it will require a greater weight per horse-power per hour than it will if the valve gear is cutting off at 60 per cent, which is, of course, contrary to Prof. Dalby. If he is right, then an invariable relation exists in every locomotive, other things being equal, between the quantity of coal put into the fire-box and the horse-power of the engine. Indeed, he expressly states that waste is represented by sparks ejected from the chimney, and that "the change in efficiency is small, notwithstanding large changes in the indicated horse-power." Our readers will, we feel sure, agree with us that this is a very remarkable proposition as it stands. It certainly comes as a discovery, for so far as we are aware no one has ever hinted at the existence of an invariable relation between the quantity of coal put into a boiler furnace and the power got out of the steam resulting from its combustion. It has, of course, long been known that the power depends on the quantity of coal burned. Some years ago Mr. Wolff, in his book, "Modern Locomotive Practice," put this very tersely by saying that at high speeds the maximum horse-power a locomotive can exert is practically a constant, being determined by the amount of water the boiler can evaporate. If this were what Prof. Dalby means, then he would not have claimed to have made a discovery. Perhaps Prof. Dalby will favor us and our readers with a correction quite necessary if we have failed to understand him.

It is worth while to give a few figures showing what must take place in a locomotive working up 1,000 indicated horse-power. The weight of steam required will be about 25 pounds per horse per hour, or a total of 25,000 pounds. To evaporate this would demand at least 3,500 pounds of coal. The grate area is about 22 square feet in the engines of which Prof. Dalby speaks. Therefore, to burn 3,500 pounds of coal per hour, nearly 160 pounds must be burned in the same time per square foot, which at 52 miles an hour means a consumption of about 70 pounds of coal per train mile. Nothing approaching these figures obtains continuously on any English railway. That a big modern engine can be made to indicate considerably over 1,000 horse-power for short spurts is quite well-known, but this is a very different thing from a continuous effort such as Prof. Dalby appears to have had in mind.—The Engineer.

The Effect of Silver, Bismuth, and Aluminium on the Mechanical Properties of "Tough-Pitch" Copper Containing Arsenic

BEFORE the Institute of Metals, Mr. F. Johnson stated that he melted electrolytic copper in a crucible, and added the desired quantity of arsenic in the form of an alloy of arsenic and copper; then the pure metallic silver, bismuth, or arsenic was added, the metal well stirred, and samples poured from time to time till the flat surface of the solidified ingot showed that the metal was at "tough-pitch." An ingot 6½ by 1¼ by 1¼ inches was then cast in an open chill mold, reheated to a bright red heat, and rolled to a rod 4 feet long by ½ inch diameter. From these rods pieces were cut for the mechanical tests (bending, alternating stress, malleability, and tensile stress) and for chemical analysis. The chief results are as follows: All the "tough-pitch" samples containing arsenic (0.26 to 0.52 per cent) show improved mechanical properties over the "tough-pitch" pure copper similarly treated. The presence of arsenic lowers the percentage of oxygen needed to bring the copper to "tough-pitch." After hot-rolling, quenching confers greater toughness on the bars than slow cooling. Silver up to 0.175 per cent in presence of arsenic, does not impair the hot-working properties. It increases tensile strength and raises the elastic limit. It does not seem to influence the "tough-pitch" stage. Bismuth is detrimental even in presence of arsenic, but as much as 0.05 per cent, with 0.3 to 0.4 per cent of arsenic, is not ruinous. Hot-working improves the metal containing bismuth, for further mechanical treatment. The effect of bismuth is to raise the tensile strength and extensibility, but to lower the elastic limit and resistance to alternating stress. It causes more oxygen to be required to reach "tough-pitch." "Tough-pitch" pure copper with 0.02 per cent of bismuth is much worse mechanically than "tough-pitch" arsenical copper with 0.05 per cent. Aluminium added to "tough-pitch" arsenical copper so as nearly to deoxidize it (0.014 per cent) does not affect its hot-working properties, but lowers its tensile strength, while increasing its toughness and ductility. Excess of aluminium, however, (0.3 to 0.4 per cent) is disastrous to the hot-working properties of the metal, and impairs its mechanical properties in the rolled condition. Microscopic examination shows that bismuth separates out from copper containing it, on solidification, in elongated plates or crystals, which separate the crystals of copper from one another. Excess of oxygen appears to cause the bismuth to separate either as metallic globules or as irregular masses of a bismuth oxide, which have not the same effect in weakening the structure as the long streaks of bismuth in copper containing no oxygen.

In an address in geography before the British Association for the Advancement of Science, Prof. A. J. Herbertson, in the Geographical Section, reviewed the progress of the science, and in the course of his remarks urged the need of establishing a government Hydrographical Department. The absence of such a department would be recognized as serious if they considered how their water supply was limited, and how much of it was not used to the best advantage. He also argued that the information which many government departments were accumulating would become much more valuable if it were discussed geographically, and if statistics were mapped and not merely set out in columns of figures. Many Blue-books would be made interesting and more widely used if their facts were properly mapped.

Some of the plants of the family *Cruciferæ* which grow in pastures are distinctly poisonous. Among these dangerous plants are various species of mustard. The field mustard, or charlock, which is very common in many parts of France, is particularly dangerous. The black mustard appears to be less irritant, but it is not free from poisonous qualities. Its seeds seriously affect the health of cows and make their milk unwholesome. The white mustard is still less poisonous, but not entirely innocent.

Modern Governing Mechanisms*

A Review of American and European Devices

By Warren H. Miller

Of the various governing systems used by European and American builders of gas engines and means for varying the explosion pressure, and consequently the mean effective pressure, may be classified as follows:

1. Constant volume of charge and variable ratio of gas to air.

2. Constant ratio of gas to air and variable volume of charge.

3. Variable ratio of gas to air and variable volume of charge.

For small engines means for simply varying the

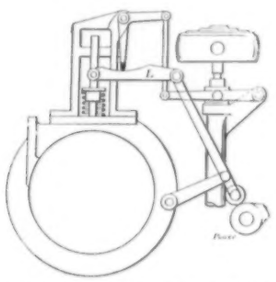


FIG. 1.—OTTO-DEUTZ MOVABLE-FULCRUM GEAR

stroke of the inlet valve will answer for regulation by varying the quantity of a constant-ratio mixture, and this is used in the original Deutz gears illustrated in Fig. 1. The governor alters the position of the fulcrum of the inlet-valve lever *L* and thereby changes the stroke of the inlet valve. In large engines, however, it is usually not practical to depend on the stroke of the inlet valve alone to determine the quantity of mixture admitted, without imposing too much work on the governor and robbing it of its sensitiveness, or else incurring the liability of the valve to reopen under the suction when only light charges are to be admitted. For this reason nearly all the large governor mechanisms include a mixing valve through which the governor controls the mixture, in addition to the main inlet valve for admitting the charge to the cylinder and keeping it there. Fig. 2 illustrates the Deutz mechanism used on large engines, the engraving being made from a drawing of the 2,000-horsepower size. The governing is by throttling and the volume admitted is controlled, as in the small engine, by means of the movable fulcrum; shifting the fulcrum *f* alters the stroke of a pair of balanced gas and air valves, and the fulcrum at the left of the air-valve spindle is also shifted, still farther altering the opening of the gas valve. The ratio of gas and air can be altered to suit the quality of gas by turning a handwheel which moves a sliding cage on the inlet-valve stem.

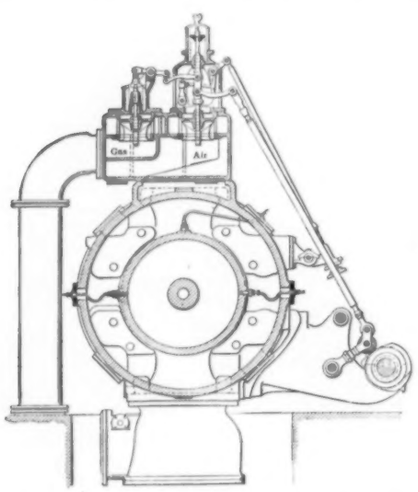


FIG. 2.—DEUTZ VALVE GEAR FOR LARGE ENGINES

Fig. 3 shows the form of shifting fulcrum gear devised by the Nürnberg company for varying the opening of the inlet valve. The governor shifts the roller *R* and thereby varies the "leverage" of both the rocker arm *A* and the valve lever *L*.

Fig. 4 illustrates the cut-off governor gear of the Société Alsacienne. It is somewhat similar to some of the American mechanisms in that it embodies a ported-cage mixing valve. The inlet valve has a constant lift. The mixing valve, shown in section in Fig. 5, is a sliding cylinder with ports registering with ports in the housing which open into the gas and

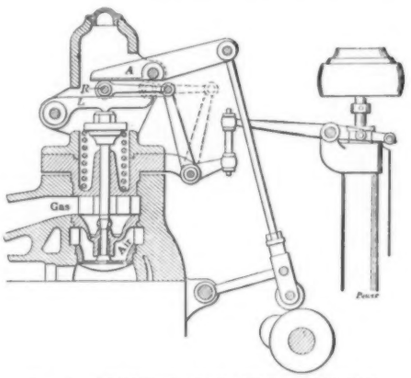


FIG. 3.—SCHMITZ MOVABLE-FULCRUM GEAR

air mains. It is divided circumferentially into air and gas ports in the correct ratio for the quality of gas used. This valve remains normally down, shutting the ports, as shown in Fig. 4. With each stroke of the eccentric rod operating the inlet valve, the valve is lifted until the ports register with those in the housing and latched in that position, allowing gas and air to flow through to the cylinder until the valve is released by a trip gear under the control of the governor; when the latch is tripped, the valve drops, shutting the ports.

Fig. 6 shows the mixing-valve gear used on the large size of the Nürnberg engine, which is probably more familiar to American engineers than any other Continental engine. Air is admitted throughout the suction stroke and the gas is admitted toward the end of the stroke, both being shut off simultaneously at the end of the stroke. The quantity of gas admitted is varied by opening the gas valve earlier or later in the stroke; regulation is effected, therefore, by varying the quality of the mixture, the volume being constant. Fig. 6 shows only the mechanism that operates the mixing-valve, of which there is one on each cylinder, placed midway between the two inlet valves, which have constant lift and are opened by the usual cam-rod-lever combination. A bifurcated arm *A* is pivoted at its fork ends to the outer housing and linked at the other end to one end of the bell crank *R* which is controlled by the governor. The valve-operating lever *B* is pivoted at its inner end to the cylindrical member *C*, which slides within another cylinder *E*, attached to the stem *S* of the valve; the lever *B* has a sort of rolling fulcrum on the arm *A*, and when the governor lowers the outer end of this arm, the "heel" of the lever *B* strikes the face of the arm *A* later in the stroke and therefore opens the valve later and reduces the explosive mixture. The lever *B* opens the valve by lifting the sleeve *E* through the medium of a dog *D*, pivoted to the plunger *C*, and this dog is tripped at the end of the suction stroke, no matter at what point the valve is opened. When the dog is tripped the valve is closed by the helical springs in the bonnet.

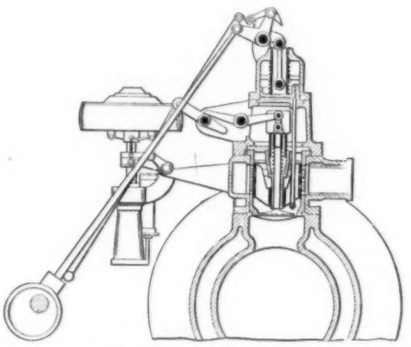


FIG. 4.—ALSACIENNE VARIABLE CUTOFF GEAR

The governor gear of the John Cockerill Company, of Seraing, Belgium, also belongs to the variable-quality constant-volume class, but the mechanism is so designed that it can be used for either quantity or quality regulation. Fig 7 shows longitudinal and transverse sections of the Cockerill engine cylinder and the principal features of the valve gear.

The inlet valve has constant stroke and a sliding air valve moves with it, so as to admit air synchronously with the opening of the inlet valve. The gas valve is mounted above the air valve on a concentric sleeve, and its actuating lever *L* is normally latched at the outer end by the dog *D*. When the push rod *R* is forced upward by the inlet cam it opens the inlet valve and at the same time compresses a spring in the housing *S* which is attached to the lever *L*. This would open the gas valve but for the latch *D*, and this latch is tripped by the governor sooner or later in the stroke, allowing the spring at *S* to open the valve. The valve is closed at the end of the stroke by the downward motion of the housing *S*, due to the fall of the push rod *R* when released by the main cam.

The tripping rod *T* is moved back and forth by a small eccentric on the main shaft, and its engagement with the dog *D* is timed by the governor through a mechanism which shifts the pivot of the intermediate rocker arm.

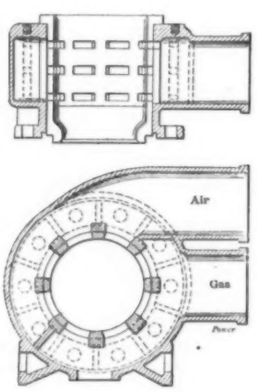


FIG. 5.—ALSACIENNE MIXING-VALVE

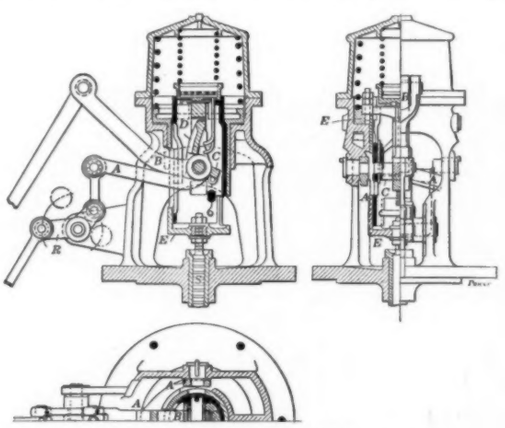


FIG. 6.—NÜRNBERG VARIABLE CUTOFF GEAR

By extending the hollow spindle of the gas valve downward, unpinning the air valve from the inlet-valve stem and attaching it to the gas-valve spindle, the gear can be changed to quantity regulation.

A very interesting English gear operating on the variable-quality constant-volume plan is that of Crossley Brothers, shown in Fig. 8. The usual cam-rod-

* Power and the Engineer.

lever system opens the inlet valve against a spring. The nut *M* on the inlet-valve stem tends to carry the gas-valve down with the inlet valve by compressing the spring *K*. The gas-valve disk *G* carries an upward cylindrical extension *H* which terminates in a vacuum piston *P* and incloses the spring *K*. A protected opening *O* allows air to pass in and out of the space below the piston *P*, and a check valve *N* prevents the entrance of air above the piston, but allows the escape of any that may be there. A "bleeder" valve *J*, controlled by the governor, allows more or less air to enter the vacuum cylinder and vary the upward pull of the piston *P*. When the spring *K* is compressed by the downward movement of the inlet valve, it presses the gas valve open more or less, according to the amount of air admitted by the valve *J* and the resulting degree of vacuum that a given downward movement of the piston *P* can form above it.

As all of the American gears excepting that of the Bethlehem Steel Company's engine have been fully described in Power, there is no need to discuss any but the Bethlehem gear in this article. Fig. 9 is a sectional elevation of the mixing-valve cage and shows also the inlet and mixing valves and the immediate operating mechanism. In this gear the ported cylinder attached to the inlet-valve stem which was first used in this country on the Westinghouse engine has been applied, but the ports are cut diagonally. This makes it possible for the governor to control both the area of the port openings and the length of time that they are open, without using trips or cutoffs. The sleeve *S* is twisted about the vertical axis by the governor rod, and the relative angular positions of its ports and those in the mixing-valve plunger are thereby varied. The mixing-valve plunger is attached to the upper end of the inlet-valve stem and moves up and down with invariable stroke, under the pressure of the cam *C* and the usual seating spring, which is not shown here. At full load the ports in the housing sleeve register completely with those in the plunger, and since the total time that they connect is one-half of that for continuously registering ports, the area of the ports must be twice as great to pass the same amounts of gas and air. When the load lightens, the governor shifts the sleeve *S* around so that at each stroke the ports in the sleeve and those in the plunger overlap less and less, until at very light loads they register only during the latter part of the stroke. As the ports are very wide and slant at a considerable angle, the governor has a very long "selective" range, the total movement in an 800-horsepower engine being about 3 inches on the surface of the sleeve and 7 inches at the pin on the outer end of the arm.

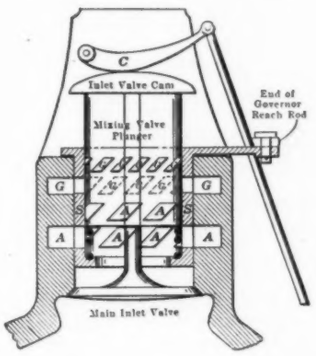


FIG. 9.—BETHLEHEM MIXING AND INLET VALVE AND CAGE

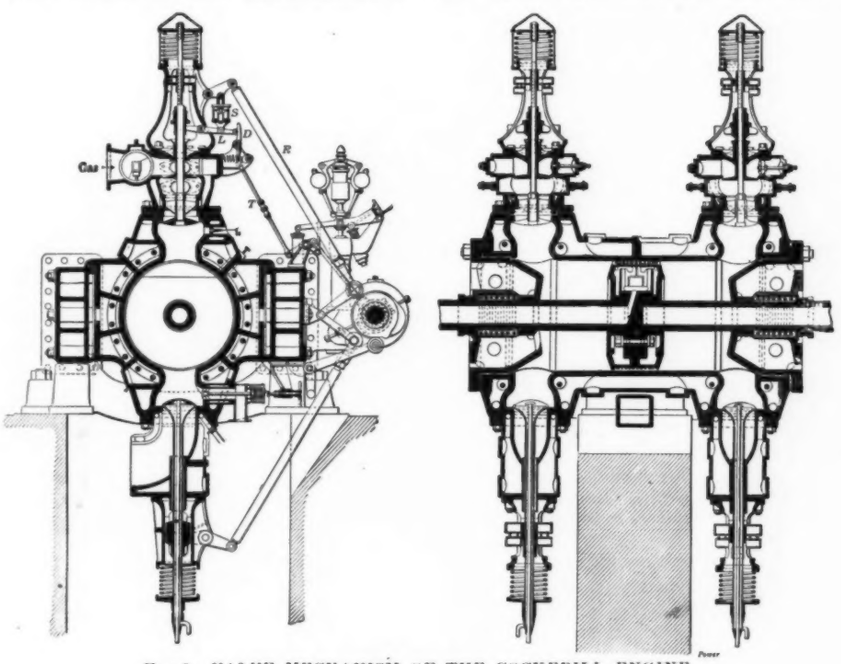


FIG. 7.—VALVE MECHANISM OF THE COCKERILL ENGINE

This gear is the latest one that has been developed in American practice, and both this and the Westinghouse gears constitute an advance over English gears up to the present time in that they provide a variable cutoff without the use of any complicated trip arrangements or multiplicity of levers, links, cams, etc.

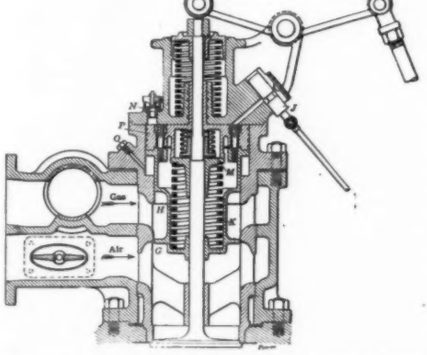


FIG. 8.—CROSSLEY REGULATING MECHANISM FOR LARGE ENGINES

The Sterilization of Milk

By DR. M. SEIFFERT.

THE unsanitary and economically defective method of transporting milk in cans and pouring it repeatedly before it reaches the vessel of the consumer is still in general use. In this way the milk is exposed to contamination of many kinds, and the visible impurities which it collects are not the least dangerous ones. The employment of cans for the transportation and sale of milk is also open to the objection that, even when no fraud is intentionally practised by the dealer, one customer may receive milk which contains much more than the normal proportion of cream, while another receives what is virtually skim milk. Unfortunately, however, the bottles and the method of sealing them which are now in use possess serious defects. The so-called patent bottles, which are closed by a porcelain stopper and a rubber ring, are condemned by the bacteriologist because they cannot be cleaned and freed of bacteria so perfectly as to make them fit containers for a liquid so prone to decomposition as milk. The bottles covered with paper caps are objectionable because the caps and the mouths of the bottles are handled in transport and therefore necessarily become conveyors of germs. Furthermore, it is not practicable to make or to apply the caps by absolutely aseptic processes.

The new "uviol" method of bottling milk uses a seal which satisfies every requirement of bacteriological science and allows a perfectly aseptic handling of the milk. This seal is a disk of tinfoil which is coated on its lower side with a germ-free stiffening material and which comes to the bottling room in a germ-free package. The bottles are sterilized before being filled and are sealed by an automatic machine, neither the seal nor the mouth of the bottle coming into contact with a human hand during the operation.

Another obstacle to the increased use of milk in large cities is the uncertainty whether the milk comes from healthy or from diseased cows. The old remedy for this state of things consisted in boiling the milk and thereby seriously impairing both its flavor and its nutritive value. The necessity of boiling all milk in order to escape the danger of swallowing disease germs has caused a great many persons to abstain from milk altogether. Those persons who prefer bottled milk in its natural condition to boiled milk are certainly far more numerous than those to whom the taste of boiled milk is not disagreeable. It is equally certain that raw milk is more effective than boiled milk in promoting the growth and increasing the blood supply of infants, whose food consists entirely of milk.

In the manufacture of butter and cheese, also, sterilization of the milk by some method other than boiling is not only desirable, but sometimes absolutely necessary. Although many butter makers pasteurize the milk, it is well known that the process injures the flavor and quality of the butter. The heating of milk used for cheese making, although it is enjoined by the new (German) cattle plague law, cannot always be employed, because it seriously affects the formation of the curd.

In the feeding of calves and pigs, also, experience has proved that better results are obtained from raw than from boiled milk, and the feeding value of such waste products as curds and whey would be greatly increased if they could be used in the raw state, without danger of infection with tuberculosis or intestinal disease.

For these reasons the "uviol" process, which destroys disease germs but spares the acidifying organisms in milk, has been developed. The process is based upon the power of violet and ultra-violet rays to paralyze the growth of vegetable organisms. The bactericidal efficiency of these rays is now universally recognized. By the "uviol" process the germs of disease, chiefly tubercle bacilli and pus-forming bacteria, which the milk of a cow may contain, even before the veterinary inspector can detect the disease and remove the animal from the herd, are killed without alterating the natural state of the raw milk.

In the industries dependent on fermentation, also, the "uviol" process will soon find important applications, as yeast and mold fungi are likewise destroyed, though less rapidly than bacteria, by ultra-violet rays.

The success which has been attained in purifying water with ozone has naturally led to attempts to sterilize milk by means of the same agent. The experiments soon proved, however, that the conditions in the two cases are entirely different. In water, the destruction of organic matter is desirable, but in milk this must be avoided, if the milk is to remain fit for use as food. The quantities, both of organic matter and of bacteria, which the two liquids contain, also differ widely. Even the results obtained in ozoning water, however, appear to indicate that milk cannot be perfectly sterilized by direct action of an electric current, because the ozone generated by the current passes through the liquid in large bubbles, making unfit for use those portions of the milk which it touches and exerting no germicidal action on the rest of the milk. In order to sterilize milk completely without injuring it, the ozone must pass rapidly through it and come into contact with every particle.

For this purpose Dr. Emil Wiener has made experiments with atomizers producing sprays of exceeding fineness, in which the diameters of the drops range from 12 to 20 millionths of an inch. As these drops are little larger than bacteria, any bacteria which they contain are fully exposed to the action of ozone coming into contact with the drops, and are instantly killed even by greatly diluted ozone. The ozone is then quickly removed from the milk by the same apparatus by which it is applied. In this apparatus the milk is atomized by a jet of compressed air, mixed with ozone. The milk falls to the bottom of a glass vessel, from which the ozonized air escapes by an orifice above the level of the liquid. Before the milk is drawn off it is thoroughly aerated by a current of compressed air which has been filtered through glass wool, calcium chloride and soda lime. In this way Dr. Wiener succeeded in freeing milk completely from disease germs and toxins and improving its "keeping" qualities, without affecting its taste, odor, or chemical composition.—Umschau.

Progress in Aviation in 1910

A Review of a Remarkable Year

By Rene Gasnier

AT the end of each year it is interesting to review the progress accomplished and the tendencies developed in aviation.

The most striking feature of aviation in 1910 is the number of remarkable exploits performed during its last few months. Nothing seems impossible to aviators. The offer of a prize of $20,000 immediately brings out new men who accomplish, often with loss of life, feats that yesterday seemed impossible. Most of the numerous fatalities are due to the breaking of parts during flight. Casualties caused by landing and by capsizing in squalls are comparatively infrequent. Hence aeroplanes should be constructed with the factor of safety employed in other constructions and, as the breaking of a part is generally irreparable, all important parts should be duplicated. Several aeroplanes with double running rigging and rudder controls have been exhibited. The Maurice Farman is especially well made in this respect, and all moving wires run on ball-bearing pullies.

The types which we had to review last year were the Voisin, Farman, Wright, and Curtiss biplanes, and the Antoinette, one-seated Blériot, two-seated Blériot, and Santos-Dumont monoplanes. We will examine the changes made in these machines this year, and briefly mention the newcomers.

Last year the Voisin obtained lateral stability from vertical partitions, which gave it the appearance of a cellular kite. This unsatisfactory device has been replaced by ailerons resembling those of the Farman. Lateral equilibrium can apparently be maintained equally well by employing ailerons or by warping the sustaining planes, although warping is evidently a more powerful means, especially in monoplanes, where it is the only method in use. In biplanes, warping slightly weakens the transverse frame. In very large biplanes, ailerons would probably be used exclusively.

Last year the Wright had an elevating rudder in front, but none behind, and was consequently very unstable. Its stability has been very greatly improved by adding a horizontal rudder behind, which works in combination with the forward rudder. This result suggested to constructors the possibility of suppressing the forward rudder altogether. This was done in the case of the Voisin biplane, which subsequently made the remarkable flight from Paris to Bordeaux. Wright and Farman have also obtained excellent results from the suppression of the forward rudder. For the present, however, Farman, together with Maurice Farman and Sommer, retains the combined forward and after rudders.

The possibility of flying with a single horizontal rudder, placed at the stern, shows that the true type is that of the French school, the monoplane constructed on the model of a bird. As I predicted last year, this form has triumphed over the American type, having a forward rudder which tends to destroy the equilibrium.

This year two new biplanes have appeared, the Brégnet and the Goupy, which resembles monoplanes in the relative positions of the sustaining planes, motor, rudder, and pilot. This is the true type of aeroplane, whether monoplane or biplane. The biplane construction allows the sustaining surface, and consequently the load, to be increased almost indefinitely. The monoplane opposes less resistance to forward motion and can therefore attain greater speed with equal power. It also maintains its equilibrium better in high winds, owing to its greater velocity and its greater weight in proportion to surface, and because its single plane is less affected by gusts and eddies than the superposed surfaces of the biplane.

Whatever the type of aeroplane, the aviator is far better protected from injury, in the event of a bad landing, if his seat is behind the motor than if he sits in front, exposed to the first shock and liable to be hit in the back by the motor.

The monoplanes have changed little during the year. The Antoinette remains exactly as it was and the one-seated Blériot has undergone very slight modifications. The Blériot with two seats beneath the wings has given place to a form in which pilot and passenger sit, side by side, in the position occupied by the pilot of the smaller machine. The Santos-Dumont remains unchanged. This machine is far safer than is generally believed and it would work well, if a sufficiently light, low-power motor could be obtained.

Among the new monoplanes, the Hanriot, which resembles the Antoinette, has performed very well in the contests in which it has taken part. The Tellier is a modified Blériot, with especially well-constructed rigging. The Nieuport is a machine of peculiar type which opposes very small resistance to forward motion. The Sommer closely resembles the Blériot. The Esnault-Pelterie looks like a great bird and in a beauty contest I would award the highest prizes to this machine and the Antoinette.

It is almost impossible to give complete and exact descriptions of the different types, because their motors and the area and curvature of the planes are not the same in all machines of the same type. One Blériot, for example, has a 25-horse-power motor, a greatly curved sustaining surface of 172 square feet, and a speed of 37 miles per hour; another has a 50-horse-power motor, a slightly curved surface of 150 square feet, and a speed of 65 miles; a third has a 100-horse power motor, a perfectly flat surface of 129 square feet, and a speed of 81 miles. The form of the curvature varies greatly in the different types. Antoinette always employs the arc of a circle, but the wings of most other machines have a maximum curvature near the front, and some have an inverse curvature close to the edge. Some machines have flexible wings. These diverse forms have been adopted after testing a few surfaces with the dynamometer. We are still far from perfection and we have no very precise data to guide us to it. All constructors, except Henry Farman, employ thick wings. The center of gravity has scarcely shifted. In monoplanes it lies almost immediately under the wings and relatively higher than in biplanes, where it is situated from 12 to 16 inches above the lower plane. The stabilizing planes contribute to support in the one-seated Blériot and the machines of both Farmans, Voisin, and Sommer, but not in the two-seated Blériot, the Antoinette, Esnault-Pelterie, or Hanriot. Which of these systems is the better? We see that Blériot employs both.

In some machines the pilot is placed in front of the motor, in others behind it. The distance between these two principal weights varies from nothing in the Wright, where the pilot sits beside the motor, to 13 feet or more in the Antoinette, which is the most sluggish in evolution of all aeroplanes. Blériot seems to have found the happy mean, which allows the bow to be raised quickly enough to land easily and safely.

All aviators are now agreed in preferring the start from wheels, which Wright, the only one who did not employ it, has at last been forced to adopt. With the great and swift machines of the future, skids and rails may again become necessary. In landing, some aviators use wheels, some skids, and some employ both skids and wheels. Blériot and Voisin rely entirely on wheels, but this is a bad plan, because the machine runs a long distance on the ground and may be upset by a stone or a hole. A better system is that employed by Farman, Sommer, and Hanriot, in which skids pushed down to the ground after striking, take the load from the wheels and quickly bring the machine to a stop. There is also a tendency to use retractile starting wheels and to land on the skids alone. In my opinion this is the best method. It has been proved that if the pilot has an unobstructed view in front he can land very gently, without employing springs, even with the heaviest machine. In monoplanes the shock of landing is often increased by the fact that the pilot cannot determine the instant of striking with precision. A skid flanked by two wheels is often used in monoplanes. This excellent plan has been adopted by Esnault-Pelterie and Nieuport.

Systems of rudder control show as much diversity as they did last year. I prefer Blériot's well-known system, which is also employed by Tellier. The same effect is produced by the single lever of Farman and Sommer. Several pilots have passed from Farman to Blériot machines and have at once guided the latter perfectly. The same movements are required in both machines—forward for rising, backward for descending, to right or left for warping the planes or inclining the ailerons—and in both the steering rudder is operated by the feet. The Blériot system, however, with its little wheel directly in front of the pilot and turned with either hand, appears more practical.

Great improvements have been made in the construction of aeroplanes during the past year. Some makers turn out machines in stock sizes, with all of their parts carefully finished. The Blériot and Esnault-Pelterie machines are particularly well made. A few aeroplane makers are beginning to construct frames entirely of steel tubes. Voisin shows a machine built of tubes which are joined without brazing. Steel tubes, in addition to their other merits, keep their shape when exposed to dampness, which rapidly warps wooden frames. On the other hand, steel deteriorates when subjected to vibration, and airship builders have encountered serious difficulties in the construction of long gondolas of steel tubing. Hence I should prefer to retain wood as the main constructive material, although steel tubes might advantageously be substituted for some of the vertical supports. The Antoinette machines are always flawless in construction. I am glad to see that several constructors are substituting steel ropes, like those used in ships, for the piano wire, which breaks so frequently.

The wooden propeller has finally won the field. This year the metal propeller is employed by Voisin alone. The wooden propeller is more efficient than the metal propeller, because it is perfectly smooth, and it is also far safer. Reducing gear is seldom used, although it presents certain advantages. Bréguet has carried five persons with a propeller geared to make 600 revolutions per minute. The direct drive is preferred, however, because of its lightness and simplicity. The diameter of the propeller, which last year was generally about 7 feet, has been increased to 8½ or 9 feet. A large propeller, geared down to 600 revolutions, would be desirable for a machine of great surface carrying several passengers, but for a small and swift monoplane the propeller attached directly to the motor shaft is preferable. Twin propellers are used in few machines except the Wright and the Lioré. They present little advantage and increase the chance of accident. Chauviére exhibited at the Salon d'Aviation an interesting device for testing propellers on an automobile.

Many pages might be devoted to motors. Last year we had few light-weight types, but there are many this year. At the head of the list stands the admirable Gnome motor with which many of the remarkable recent feats of aviation have been accomplished. Many persons, at first, did not believe in the rotary motor, but they have been compelled to accept the facts. This admirably simple device represents the true type of aeroplane motor and a step toward the ideal turbine motor. Many motors with four and eight cylinders are highly esteemed, but none of them rivals the Gnome in lightness. Among the air-cooled motors the Esnault-Pelterie is remarkable on account of the severe tests which it has passed successfully. Still more notable is the splendid performance of the Antoinette water-cooled motor which accomplished 1,300 miles in one week at the Bordeaux meeting. This would be a pretty good record for an automobile. The aeroplane motor is evidently becoming sharply differentiated from its elder brother, the automobile, and is assuming a form especially adapted to its own work. Aviators are beginning to demand, in addition to the greatest attainable lightness, a small consumption of fuel and a range of speed which is indispensable for landing. It is dangerous to descend rapidly with the motor working at full speed, but if the ignition is cut off and the descent made by soaring it is impossible to start the motor again if a forward impulse is needed on approaching the ground. If the motor would be kept going at a very slow speed, which could be increased at the critical moment, the descent could be made with perfect safety.

Two very original and interesting aeroplanes were exhibited at the Salon by Fabre and Coanda. The Fabre machine is the only aeroplane that has ever risen from and alighted on water. Its trussed frame appears very strong, but it would be better to conceal the trusses inside thick wings. The Coanda aeroplane has a fantastic appearance. The resistance to progression is reduced to a minimum. The form of the wings, which are made of wood, was adopted after numerous tests made on rapid railway trains, but the wings appear weak, as they have neither vertical nor horizontal braces. This machine is to be driven by a turbine which the inventor expects to develop astonishing power.

Inventors have not made much progress this year. The Salon had little to show except slight improvements on the types of last year. The audacity of the pilots, however, stimulated by the offer of large prizes, has revealed unsuspected qualities in the aeroplanes. Let us hope that the invention of new types will be similarly encouraged next year. The dearth of novelties at the Salon does not mean that Blériot, Farman, Voisin, the Wrights, and other inventors are resting on their laurels. All of them are testing new machines, but only a novice can venture to exhibit an invention in the experimental stage.

A general tendency toward uniformity of type is noticeable. The monoplane and the biplane are progressing along the same lines, although their goals are different.

The time has come to build touring aeroplanes which will not break in the air. The pilot and the passengers should be comfortably installed in cars securely mounted inside the frame, where they will be protected as completely as possibly against the violent shock which is always liable to occur in landing on bad ground.

A good method of quickly stopping the aeroplane, after landing, is required. There is still room for much improvement in the forms of wings and propellers, and in diminishing the resistance to progression. It is also necessary to organize soaring contests and to offer large prizes for the smallest angle of ascent. At present, what is called a soaring descent is a swift motorless dash down a grade of nearly 15 degrees.

These are a few of the important problems that await solution. With the motors now available this year's astonishing feats of aviation can easily be surpassed. In 1911 we may expect to see the long-distance races which marked the early years of the automobile repeated with aeroplanes.—Translated for the SCIENTIFIC AMERICAN SUPPLEMENT from L'Aerophile.

The Limits of Our Chemical Knowledge

Some Modern Problems

By Dr. William Eichholtz

THE last few years have enriched science and technology with discoveries and inventions of the most sensational character. It is not surprising that a generation which has witnessed the discovery of Roentgen rays and radium, and the development of wireless telegraphy, airships, and aeroplanes, should become *blasé*, and refuse to be greatly impressed by anything. The brilliancy of the new discoveries casts into the shade the years of patient toil which preceded them, and also the numberless problems that yet remain unsolved.

We know to-day that there is no specific "vital force" which gives vitality to all living creatures. We think we know that life is merely the sum of the biochemical processes which take place in the individual cells of the organism, and that these processes are governed by the same laws that govern chemical reactions in the laboratory. But the chemical processes of the body, though similar to those which we have learned to control in the laboratory, are exceedingly complex, and we know very little of their details.

Many persons are surprised when they are told that it is impossible, in some cases, to detect adulteration of food, and can scarcely believe that science is still so impotent. Most articles of food are natural products and consist mainly of the very complex organic substances. When it is explained that we do not know the chemical structure of albumen, the most important constituent of every animal and vegetable cell, and that most of the substances which give foodstuffs their characteristic flavors and odors cannot even be chemically defined, it may be understood why the chemist finds it very difficult, and often impossible, to distinguish pure from adulterated wine, or genuine from artificial butter.

The statement that we do not know the chemical structure of albumen does not mean that we are entirely ignorant of the composition of albumen. We know that albumen contains certain chemical elements, combined in certain proportions, but this knowledge does not give a mental picture of the structure of the albumen molecule.

Quantitative analysis suffices to explain the composition of most minerals and inorganic salts, but the quantitative determination of the elements of an organic compound gives little knowledge of the chemical structure and character of that compound. In view of the small number of elements—carbon, oxygen, hydrogen, and nitrogen—which make up most of the countless and infinitely diverse organic compounds, percentages mean nothing, and arrangement or structure is everything. In many instances two or more obviously different substances have precisely the same percentage composition. For example, formaldehyde, the aqueous solution of which is well known under the name formalin, is identical in percentage composition with grape sugar and some other carbohydrates.

The chemical investigation of natural products is made more difficult by the almost invariable association of a number of similar and nearly related "homologous" compounds. Butter, for example, contains a long series of fatty acids, which shade into each other so gradually that the series can only be resolved into a number of groups, which defy analysis into their individual members. Fruit juices similarly contain series of organic acids.

The systematic methods of inorganic analysis are therefore inapplicable to organic bodies and the reproach cast upon food analysis has very little justification, for it is not, and it never will be, possible to determine the ingredients of animal and vegetable products by the rigid system and with the absolute certainty with which a skilled chemist can analyze the most complex of inorganic substances.

In many cases, the adulteration or falsification of food products can be detected only by means of some unimportant ingredient which happens to produce a striking reaction. For example, genuine honey contains microscopic grains of pollen. If these are absent, the genuineness of the honey may be doubted. Unfortunately, however, the adulterators keep pace with the progress of science and mix artificial pollen grains with their artificial honey. All margarine sold in Germany must, according to law, contain an admixture of oil of sesame, which produces a brilliant color when the reagent furfurol is added. Without this admixture of oil of sesame, it would be very tedious and difficult to distinguish margarine from butter. This can be done, in some cases, by determining the proportion of volatile fatty acids, which are usually more abundant in butter than in margarine. The quantity of these volatile acids in butter, however, varies with the season, the stage of lactation, and the breed of cows, and it sometimes falls below the prescribed limit. It is especially difficult to discover whether a specimen of butter is adulterated with margarine, and if so, to what extent, and in many cases it would be quite impossible to detect such adulteration without the compulsory "latent coloring" of margarine with oil of sesame.

The detection of adulteration and falsification in wine is still more difficult. It is known that there are mixtures sold as wine, which contain not a drop of grape juice and which yet defy detection by chemical analysis. The chemist cannot even distinguish the coloring matter of red wine from that of huckleberries, probably because the two are chemically identical.

The consumer, however, cares nothing for chemical identity. He wishes to know the source of his food, but in this inquiry the chemist is restricted to limits fixed by nature. In one instance these limits have recently been transcended, but not by the chemist. The nice discrimination between varieties of albumen which chemistry is unable to make has been brilliantly accomplished by biological science.

If an extract of horse flesh, or the serum of horse blood, is injected repeatedly during a considerable period into the circulation of a rabbit, a substance called an antitoxin, which precipitates the albumen of horses, and that alone, is formed in the blood of the rabbit. Hence, if the serum of the rabbit which has been thus treated is mixed with an extract made from suspected meat, the presence of horse flesh in the meat will be indicated by the formation of a precipitate. This method is already extensively employed for the detection of horse flesh in sausages. An antitoxin which precipitates human albumen alone, and which is useful for the detection of human blood in the investigation of crimes, is prepared by a similar process.

This biological reaction, which is called Uhlenhuth's reaction, from the name of its discoverer, is distinguished from most chemical reactions by its delicacy and precision. It can be applied with success to exceedingly small quantities of matter.

Our chemical knowledge, then, is still very imperfect, but it must not be forgotten that chemical problems are proposed by nature and are as numerous as the products and processes of nature. Every natural product theoretically presents three problems: its composition, its utility, and its artificial or synthetic production.

Technical problems which are not of chemical nature are usually accompanied by their solutions on their first appearance.

The necessity of traveling 60 miles an hour was not felt until long after the steam engine had been invented. Such wants are rather suggested, and slowly impressed upon conservative humanity, by the existence of means of supplying them. Hence technical inventions are thankfully received as unexpected gifts, while chemical discoveries are regarded as long deferred payments of just dues. There are exceptions, however, to both of these rules. The problem of flight has occupied humanity for thousands of years and, on the other hand, synthetic chemistry has given us medicines, dyestuffs, and other substances which have become indispensable, although they occur nowhere in nature, but were created in the chemical laboratory.—Ueber Land und Meer.

How Birds Work Together

TURNSTONE is the name of a variety of shore-birds that are allied to the plovers and the sand-pipers. This name has been given to them because of their singular manner of feeding. With their strong bills they turn over the small stones lying in the sand of the beaches to find the insects that may be sheltered underneath. If the stone prove too heavy for the bill, they push it over by applying the breast to the upper side. Frequently a number of these birds will work together to turn over an object that is too heavy for one alone to move.

Two little workers were once seen busily endeavoring to turn over a dead fish that was fully six times their size. They were boldly pushing at the fish with their bills and then with their breasts. Their endeavors were, however, in vain, and the object remained immovable.

Then they both went round to the opposite side and began to scrape away the sand from beneath the fish. After removing a considerable quantity, they again came back to the spot where they had been, and went once more to work with their bills and breasts, but with as little apparent success as before. Nothing daunted, however, they ran round a second time to the other side and recommenced their trenching operations with a seeming determination not to be baffled in their object, which evidently was to undermine the dead creature before them in order that it might be the more easily overturned.

While they were thus employed, and after they had labored in this manner at both sides alternately for nearly half an hour, they were joined by another of their species, which came flying with rapidity from the neighboring rocks. Its timely arrival was hailed with evident signs of joy.

Their mutual congratulations being over, they all three set to work, and after laboring vigorously for a few minutes in removing the sand, they came round to the other side, and putting their breasts to the fish, succeeded in raising it some inches from the sand, but were unable to turn it over. It went down again into its sandy bed to their manifest disappointment.

Resting, however, for a space, and without leaving their respective positions, which were a little apart the one from the other, they resolved, it appeared, to give the work another trial. Lowering themselves, with their breasts close to the sand, they managed to push their bills underneath the fish, which they made to rise about the same height as before. Afterward, withdrawing their bills, but without losing the advantage which they had gained, they applied their breasts to the object. This they did with such force and to such purpose that at last it went over and rolled several yards down a slight declivity. It was followed to some distance by the birds themselves before they could recover their bearing.

To Color Tin Solder Yellow.—Prepare first a saturated solution of blue vitriol in water, dip a polishing stick into it with which the place to be soldered is moistened. Touch the spot thus moistened with an iron or steel wire or rod. If this is frequently repeated copper will be deposited. To produce yellow color the spot is moistened with a mixture of 1 part of saturated aqueous solution of white vitriol and 2 parts of blue vitriol solution by means of a zinc rod. The spot is to be finally rubbed with gilding powder and polished with the burnisher. In the case of gilded objects, the coppered spot should be coated with a thin covering of gum or isinglass solution, dusted with bronze powder, and after drying, brushed smooth. For silver articles the coppered place is to be rubbed with silvering powder, brushed and polished.

The Temple of Hibis*

Results of the Metropolitan Museum's Expedition

By H. E. Winlock

DURING the past winter the Egyptian Expedition of the Museum has conducted the excavations at the Temple of Hibis in Kharga Oasis. The temple is one built chiefly in the reign of Darius the Great, about the beginning of the fifth century before Christ, and its clearing was undertaken by the expedition because of its importance as the only architectural monument of the period between the decay of the Theban Kingdom and the conquest of Alexander the Great which exists to-day in good preservation.

Prof. Gaston Maspero, Directeur Général du Service des Antiquités d'Egypte, assigned M. Emile Baraize, an engineer of the service, to the task of consolidating and restoring the temple at the expense of the Egyptian government while it was being cleared by the expedition. The latter owes its acknowledgments to Prof. Maspero for making it possible to conduct the two pieces of work—the clearing and the restoration of the temple—in co-operation, and especially to M. Baraize for his unfailing helpfulness, not only in the special task he was undertaking on behalf of the service, but also in all of the other work connected with the excavations. The collating of previously published copies of the temple hieroglyphic inscriptions with the originals and the copying of inscriptions and scenes which have not been published heretofore or which have been brought to light during the past winter were started by N. de G. Davies of the expedition. In connection with and supplementing the Davies copies Friedrich Koch has begun a series of photographs which it is hoped to finish during the coming season, and which it is intended shall be a complete record of all the reliefs and inscriptions in the temple. The Greek decrees mentioned in the expedition's last report, as well as some new decrees, shorter inscriptions, and graffiti found this year, have been copied and are being prepared for publication by H. G. Evlyn-White, while the plans and architectural drawings are being done by William J. Jones, both of whom are members of the expedition.

The field work in the oasis began the first of December. As the temple is situated in the midst of the peasants' farms, the first step was to open negotiations with the land owners of the neighborhood, with a view to procuring a place where the earth and sand from the excavations could be dumped and obtaining the title to some of the land in private possession adjoining the ruins which it was desirable to dig. Eventually an arrangement was made by which the expedition was able to dump into a low salt marsh at the foot of the temple hill, and in exchange for this filling and improvements of their lands, the owners gave up some of the land about the eastern gateways. These questions took up a great deal of time throughout the winter, and their ultimate solution was almost entirely due to M. Baraize, but meanwhile, about the middle of December, a preliminary agreement had been arrived at, a light railway was installed similar to that which had been in use at Lisht, and excavations were begun at the portal of Darius and pushed westward. From the very beginning of the excavations, fallen blocks from the temple were found, buried to greater or less depths in the soil and drift-sand. First to be cleared was the portico of Nectanebo. Part of the screen walls of the north and south sides had always remained visible above the surface, but in the course of the excavations practically all of the columns and cornice which had risen above these two sides were brought to light, lying just as they had fallen, each stone in relation to the next in such a way that a reconstruction of the elevation could be definitely made. As the work proceeded through the great eastern doorway of the temple, the fallen blocks were found in greater and greater numbers until, when inside the large hypostyle hall, the removal of the sand brought to light a mass of stones in great confusion, filling the hall to a depth of several meters above the pavement (Figs. 5 and 2). These were the drums and capitals of six fallen columns and the architraves and roofing-slabs which had been supported by them. Most of the columns could be completely recovered, but the majority of the pieces from the roof were so broken that to restore them to their orginal positions was found to be impossible. In order to continue the clearing, all of them had to be removed, but as the greater part were extremely massive the process was slow and difficult (Fig. 1).

At this time the force of workmen numbered nearly two hundred; and as it was impossible to employ so many in the hypostyle, the majority were transferred to the excavation of the exterior. Eventually, as the entire task of transporting the blocks in the hypostyle was undertaken by M. Baraize, all of the expedition's workmen were engaged in running spurs of the light railway around the north and south sides of the temple, and in clearing away the larger drifts of sand and débris collected there. In this way two side-openings were found into the offering hall, by which the chambers in the back of the temple could be entered and cleared while the hypostyle was still blocked. The excavations on both sides of the temple were carried on by means of the railway down to the ancient surface level. To the north an area of over one thousand square meters was dug in this way to a depth of two or three meters, and sounding trenches were sunk below the surface to bed rock. On the west the work had to be stopped within ten meters of the temple wall; but on the south, where the cultivation did not approach the temple so closely, a much larger area, covering about three thousand square meters, was cleared (Fig. 3). The work at this point was extended early in February to a low mound rising on the edge of the cultivation where traces of buildings had been found on the surface. The greater part of the rest of the season was spent in exploring the network of mud-brick walls uncovered here. At the end of the work some modern structures were removed from among the eastern gateways, but no other attempt to excavate in the palm grove has yet been made. The work in the field was brought to a close the first of May.

The consolidation and restoration of the temple by M. Baraize was begun about the middle of January and continued to the end of the season. A great deal of this time was spent in replacing with new masonry the stones in the lower courses which had been eaten away by the moisture and salts in the soil in which they had been buried, in order to make the walls capable of sustaining their own weight after they were exposed. In the case of one partly fallen column in the hypostyle hall, this operation necessitated the taking down of the standing courses and the complete renewal of the foundations. In addition a great deal of the fallen structure recovered in the clearing was restored to its original positions. In the hypostyle two of the six fallen columns were set up again and some parts of the screen wall and columns of the offering hall; a great many blocks of the fallen cornice from the exterior and some of the frieze at the top of the walls inside the temple were replaced; and the greater part of the west wall of the temple was rebuilt from the bottom courses to its original height, such of the blocks as were missing being replaced with new masonry. The restoration is to be continued next year in conjunction with the further excavation.

The clearing and rebuilding of the Temple of Hibis has disclosed new features in the plan and decoration, including some interesting reliefs which have been brought to light on walls heretofore buried. One shows the king, Darius, in a boat, picking papyrus flowers to offer to the god Min, and another, the god Sutekh the popular deity of the oasis, slaying the Serpent of Evil (Fig. 4). In the ruins of the portico of Nectanebo there was found, besides the complete columns from the north and the south rows which are to be re-erected, an isolated capital of elaborate papyrus-flower form in excellent preservation, with

FIG. 2.—HYPOSTYLE HALL, LOOKING EAST AFTER THE REMOVAL OF THE SAND, SHOWING FALLEN ROOF AND COLUMNS

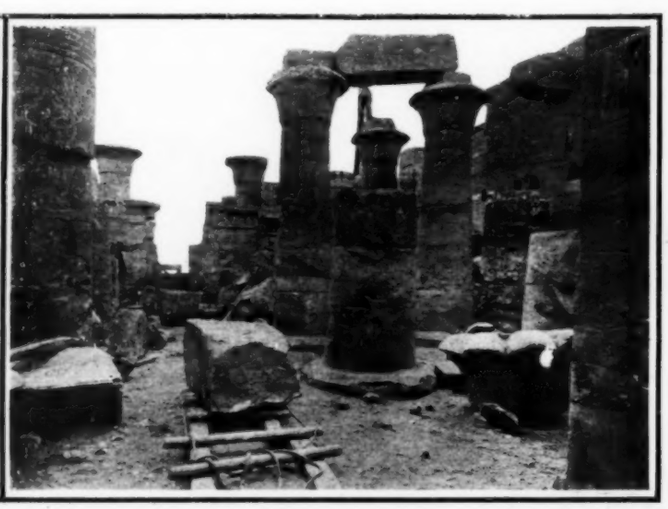


FIG. 1.—HYPOSTYLE HALL, TEMPLE OF HIBIS, KHARGA. LOOKING WEST, DURING THE COURSE OF THE REMOVAL OF THE FALLEN BLOCKS

THE EGYPTIAN EXPEDITION

* Bulletin of the Metropolitan Museum of Art.

its coloring almost intact. It is probably the capital of one of the four columns of the almost completely destroyed eastern façade, but although its position has been ascertained with a good deal of certainty, not enough of the column and substructure remains to replace it. It has therefore been brought to the Metropolitan Museum of Art.

Additional knowledge of the history of the temple has been gained also by the excavations. A fragment was found of an offering bowl of dark blue schist, way like those at Kom Ombo and Edfu has been discovered and dated to the reign of Ptolemy II, Philadelphos (B. C. 285-247) from a fragment of the dedication inscription in Greek. Among the fallen blocks of this wall there have been found a great many pieces of relief of the reigns of Ptolemy III, Euergetes (B. C. 247-222) and of a later Ptolemy and his consort Cleopatra, but it is impossible to tell yet whether they come from decoration of the wall itself or from some other structures which may have ex-

ment and one Heraklios built piers in the hypostyle to support the then endangered roof.

But from the third or fourth century after Christ evident signs of decay are noticeable. The inclosure walls were broken in places and private houses encroached on the temple area. From these the excavations recovered coins, ostraka, a bronze lamp, and a good deal of pottery. At the abandonment of the temple as a place of pagan worship the dwellings were built against the outside walls and among the col-

FIG. 4.—RELIEF FROM NORTHWEST CORNER OF HYPOSTYLE HALL. SUTEKH SLAYING THE SERPENT OF EVIL. REIGN OF DARIUS

FIG. 3.—GENERAL VIEW OF THE EXCAVATIONS SOUTH OF THE TEMPLE. IN THE FOREGROUND PART OF THE FOUNDATIONS OF PTOLEMAIC BUILDING

FIG. 5.—HYPOSTYLE HALL VIEWED FROM THE TOP OF THE TEMPLE AFTER THE REMOVAL OF THE SAND, SHOWING FALLEN ROOF AND COLUMNS.

THE EGYPTIAN EXPEDITION

dedicated in the reign of Apries (B. C. 588-569), which had been apparently a piece of temple furniture and which therefore points to the existence of a temple on this site at least as early as the Saïte period. Of the existing temple two stages of construction have been determined earlier than the reign of Nectanebo, and in Ptolemaic times additions and changes were made which have been unknown hitherto. An exterior stone wall surrounding all of the temple except the east façade and inclosing a narrow passage-

isted near by. Indeed, the whole site seems to have flourished throughout the Ptolemaic period, as besides these structures and the inclosure wall and pylons on the east already known, there were discovered on the south the foundations of a large Ptolemaic brick structure with a stone portico and near by were found coins, pottery, and small bronze ex-votos which had been originally in the temple. This prosperity continued at least to the first centuries of the Roman period, when a certain Hermais dedicated a new pave-

umns of the hypostyle halls, and in the northeast corner there was erected a small Christian church. Fragments of glaze found in connection with this last occupation show that it continued until after the Arab conquest, archæological evidence which it is possible to verify inscriptionally by several Coptic graffiti in the tombs of the Necropolis el-Baguat and on the rocks of Gebel-et-Têr. Among these latter is a prayer signed and dated in the eighth century after Christ by Severus, son of the Pagarch of Hibis.

What is the Ether?*

The History and Necessity of a Remarkable Conception

By Owen Ely

SINCE the time of Newton, physicists have seen the need of assuming an ether to explain "action at a distance," or the passage of electric and magnetic forces through empty space. Though these phenomena have been thoroughly studied through experimental research, comparatively little work has been done to deduce from the laws and facts at our disposal the real properties and conditions of the ether. The concepts of an ether have generally been so mystical and vague that scientists have shunned the task of correlating or confirming them. But more recently science has realized the importance of this realm of inquiry. Lorentz, Larmor, Thomson, Kelvin, Lodge, and others have sought some basis of experimentation and have attempted to build complete and consistent theories. Results are slowly accumulating, more definite hypotheses are being formulated, and perhaps a few more decades will give us a fairly complete knowledge of this understratum of nature.

The first important theory of the ether was developed by Green and others, in the early part of the nineteenth century. The ether was regarded as a kind of incompressible jelly, easily set a-quiver by the motions of the molecules and able to transmit this motion, through its vast bulk, to the ends of space. And yet, for any motions of matter other than the molecular, the ether was thought to act as a perfect fluid. This provision was necessary to limit the ether to transverse vibrations. Owing to the increasing demands which new discoveries in optics made upon the theory, it was abandoned.

One of the most prominent theories which have been brought forward, was that connected with Maxwell's electro-magnetic theory of light. The ether was assumed to be a turbulent fluid, the particles of which oscillate, revolve, or in some way change their condition, causing the rapidly alternating "polarizations" which Maxwell used, to explain his conception of the electro-magnetic wave. Sir William Thomson, in the Philosophical Magazine for June, 1853, gave the theoretical demonstration to prove that the reversing of an electric charge produces a "polarization," the same in kind as that which constitutes a light-wave. Later, Hertz actually proved the identity. But "polarization" is still little more than a name, and there is yet some discussion as to whether it involves any bodily displacement of the ether.

The ether having been regarded as a solid and a fluid, it remained to treat it as a gas. This was attempted by several, among them Mendeleef, the chemist. But the results did not seem very satisfactory. Evidently, the ether needed properties of each state of matter, solid, fluid and gaseous. Rigidity and elasticity of some sort were required, that light should travel in a straight path; the freedom of movement of a perfect fluid was necessary, since apparently there was no friction between matter and ether; and finally its inertness, its failure to affect matter of itself, pointed to a lack of cohesion or activity among its particles. For these reasons, apparently, modern physicists have generally ceased trying to picture ether in terms of matter, but rather are inclined to explain matter in terms of ether. Thus Prof. Osborne Reynolds, who has worked upon his theory for many years, regards the ether as a system of finely-packed grains of which it would take same 112.10^{12} to make up an inch, and whose mean free path is 4.10^{13} of their diameter. These round, hard grains are piled up like billiard-balls through the universe, but here and there is a crack or separation, and this vacuum is matter! The encounters of the cracks make up the phenomena of the cosmos.

Larmor's concept seems somewhat similar, for he regards electrons as "nuclei of permanent etherial strains in rapid motion." Kelvin and his school lay emphasis upon an explanation of the ether's perfect elasticity. Kelvin's famous theory of the ether makes its elasticity "due to rotational motion—intimate, fine-grained motion throughout the whole etherial region—motion, not of the nature of locomotion, but circulation in closed curves, returning upon itself—vortex motion, of a kind far more finely grained than any waves of light or any atomic or even electronic structure. If the elasticity of any medium is to be explained kinetically, it follows, as a necessary consequence, that the speed of this internal motion must be comparable to the speed of wave propagation; that is to say, that the internal squirming circulation, to which every part of the ether is subject, must be carried on with a velocity of the same order of magnitude as the velocity of light."†

On this assumption, Sir Oliver Lodge calculates that the ether must possess 3.10^{11} kilowatt centuries per cubic millimeter, or "the energy of a million horsepower station working continuously for forty million years!" Kelvin's theory is based upon the principle of the gyroscope as applied to fluids, which thus imitate solids. Many experiments have been made to demonstrate the strange properties of liquids or flexible solids when in rapid motion. A silk cord moving swiftly over a pulley, has become rigid and viscous; and waves set up on the cord traveled with its velocity, thus standing still. This shows why "the speed of (the ether's) internal motion must be comparable to the speed of wave propagation." To show the elasticity of spinning bodies, Lord Kelvin made a spring balance out of gyrostats.* The "hardness" of fluids in motion is illustrated by a stream of water under strong pressure, which will resist blows from a sword.

Kelvin's gyroscopic theory, however, is useful only in providing a fluid ether with the elasticity of a solid. And does it not seem futile to evolve an ether from the properties of matter, when those properties in turn depend upon the ether? The action of the gyroscope involves the inertia of matter: yet Prof. J. J. Thomson and others are now inclined to explain inertia as an effect of the electromagnetic energy which a body carries about with it in the ether. But if inertia is not an "inherent" property of matter, but rather a phenomenon involving ether, why should it be used to endow the ether-particles? A second ether would be necessary to account for the inertia of the first. Indeed, it is so difficult to build up any hypothesis without the use of inertia and the laws of motion, that we may be compelled at last to resort to another ether. But since that is merely shifting the ultimate problem, we must do our best to gain a simpler theory.

Again, it is difficult to conceive how the particles, however "fine-grained" their gyroscopic motion, would avoid being in continual contact and collision, destroying the permanency of the system and producing a gaseous state. Motion in exact circles would be broken up and the gyroscopic principle no longer at work. At least it is difficult to explain how any kind of motion can be provided for the crowded particles of ether other than some irregular chaotic vibration like that of a gaseous molecule. The particle cannot be compared to the vibrating molecule in cohesive solids, nor to the revolving electron, for both must be held in their systematic orbits by forces acting through a medium. The difficulty of making the ether circulate about a fixed center, in order to make it gyroscopic and elastic, seems about as large as the original problem itself.

There are, perhaps, other ways of explaining the properties of rigidity and fluidity in the ether. If matter be regarded as merely a crack or strain in the ether, the latter need not be fluid, since there could be no such thing as "friction" between matter and ether. Then if the ether be thought of as quite densely packed, with particles in orderly rows, columns, and tiers, it might not be difficult to imagine how a single pulse of light emanating from a molecule should continue, like a missile having inertia, to follow the straight line upon which it was started. For light is made up of waves in several planes, which we may regard separately. Motion in one plane cannot pass into another, and if the tier of particles in which the wave started is not disturbed by passing matter, the wave would remain in one plane. But what prevents the wave from spreading about its plane, instead of holding a straight path? This, too, must be a result of the regular arrangement of the particles, so that the wave moves as a uniform interaction among the particles of several rows, confined to these rows alone, like a moving pendulum. Thus the simple pulse from a molecule in the Sun would reach our Earth practically unchanged. The size of an object, then, alters not because all the mingled pulses reach the eye diminished in size, but because the number of pulses entering the eye, undiminished, depends upon the square of the distance. Were the former the case, and if the light-wave spread out like a sound-wave as it emanated from a source, some change in the structure of wave would take place, and it would be difficult to explain the rectilinear propagation of light. The structure of the ether could scarcely be as perfect as pictured, but if the particles be of a very small order of size compared to the light-wave the result should be about the same. Only by this means, indeed, could we imagine the tubes, or parallel rows traversed by each wave, as stretching away from the source in every direction. This description, crude as it is, may serves to show that the theory of the ether has not yet been exhaustively worked, while it points out some of the difficulties in an adequate explanation of the actual transverse wave in ether.

Having reviewed some of the general theories of the ether, it will be interesting to look into the methods which have been used to gain facts and figures in regard to the ether, and to see what tangible results have been reached.

A modern school of physicists have derived a value for the elasticity of the ether from the formula $V = \sqrt{\frac{K}{D}}$ or $K = V^2D$. The density of the ether has been calculated on the assumption that the electron is a differential portion of ether but of equal density. The linear dimension of the electron is about 10^{-12} or 10^{-13} millimeters, and if its mass is not an effect of its magnetic field, the various estimates based upon different experiments all yield the same result, about 10^{12} c.g.s. units. V^2 we know to be 9.10^{20}, so that $K = 10^{21}$, the figure generally agreed upon by some of the greatest scientists. The estimate is of little value, however, except as it may direct further inquiry. The structure of the electron must be investigated before its density can safely be used to indicate that of the ether.

Deductions have been made as to the structure of the ether from the computed velocities of the various wave-lengths of light in space. But they are of questionable value, for at present it is still a moot question whether or not the various waves have exactly the same velocity. However, it is an important line of research and will certainly yield us some knowledge of the ether. We are too accustomed to treat light as a whole, not as to particular wave-lengths. Lord Rayleigh has said: "We have no means of identifying a particular wave so as to determine its rate of progress. What we really do in most cases is to impress some peculiarity, it may be of intensity, or of polarization, upon a part of an otherwise continuous train of waves, and determine the velocity at which the peculiarity travels." Rayleigh used the formula $U = \frac{d(kV)}{dk}$ to express the possibility that V, the velocity of a particular wave-length, may differ from U, the group velocity. Now the work of Nordmann on Algol has tended to show that red rays (about 0.68μ) were sixteen minutes ahead of the blue (about 0.43μ). Pritchard's estimate of Algol's parallax is 0.0556 second, or about 61 light-years. Dr. C. V. Burton, using these data and Rayleigh's formula (L. E. D. Philosophical Magazine, December, 1909) has set up equations representing the conditions of periodic motion in the ether, in order to show that the velocity of propagation is a function of the wave-length and that no absorption need occur in the ether. The laws of dispersion are applied to strings and by combination of these to three-dimensional space. The nature of the formulæ developed by him leads to the conclusion that "The system (of ether-particles) has a structure on a scale not infinitely minute compared with the wave-length. Though we may conceive the electro-magnetic vibration of the ether to be executed in a manner widely different from anything occurring in these simple mechanical models, we may yet attempt to form some idea of the coarseness of structure of the ether which could suffice to account for such dispersions as Nordmann and Tikhoff have thought to be indicated by their observations." The formula deduced by Dr. Burton from Rayleigh's equation is $U = V\infty (1 - \pi^2 b^2)\ 2\lambda^2$. When this is applied to the figures given by Nordmann and Tikhoff above, the result is only $1.7.10^{-5}$ centimeters and $3.1.01^{-5}$ centimeters, respectively, for b, "a linear magnitude which expresses the coarseness of structure of the ether." But the electron is said to be only 10^{-12} centimeters in diameter; and since the ether-particle should be of a lower order of size than the electron, this indicates that the observations are unreliable or the formulæ wrong. The fact that the two observations disagree in the ratio of nearly one to thirty has furnished an argument against the reality of dispersion. But if dispersion is proved to exist it must be attributed to the structure of the ether, since Lebedow has shown that it cannot be accounted for by the presence of any known substance in space (for example, hydrogen at low pressure), which would absorb light enough to make Sun and stars invisible.

In 1874 Clerk-Maxwell calculated the pressure of light to be about 1/23,000 of a dyne per square centi-

* Popular Astronomy.

† Lodge, The Ether of Space, (1909), pp. 102-03.

*[Address to Section A of British Association at Montreal, 1884.

meter for full sunlight; and a quarter of a century later Lebedow, Nicols, and Hull verified the theory, the two latter reaching a figure within one per cent of Maxwell's estimate. Lately Prof. Poynting has measured the backward thrust of the light-wave as it leaves its source. When we have worked out a definite picture of the electro-magnetic wave, this primary fact should be very useful in explaining its genesis and the relation of the electron to the ether surrounding it.

It has been assumed, during the above discussion, that no friction exists between matter and ether; but the question was by no means settled until recent years. Many experiments were tried during the past half century, but none were conclusive until Michelson made his famous experiment in 1887. This seemed at first to show that the ether is stagnant about the Earth, or that it does not rush by us and through us at the rate of the Earth's motion. Two half beams of light, one sent to and fro along the line of the ether drift, east and west, and the other across the line of drift, were reunited and should have shown a displacement in the bands of the spectrum of one part in a hundred million—the square of the ratio of the speed of the Earth to that of light. A change of one part in 4,000 millions could have been detected in the apparatus, but no change was seen. The explanation was first suggested by Prof. G. F. Fitzgerald, of Trinity College, Dublin, and was later developed by Prof. H. A. Lorentz of Leiden. "The cohesion of the materials in the apparatus by which the measurements were made, was probably due to electric charges in the atoms. The cohesion was then less great across the line of the Earth's motion than along it, for the reason that the charges become currents on account of the Earth's motion, and the attraction between the parallel currents is less than in the currents which follow each other in the same line of motion. Therefore, although the light-wave probably increased in velocity across the line of the Earth's motion, the stone slab across which it traveled increased in length proportionately.

An interesting and original experiment was undertaken by Sir Oliver Lodge to settle the question in a different way. Two large steel disks an inch apart were rotated at enormous speed while a beam of light was divided by a semi-transparent mirror and the two halves were sent in opposite directions around and between the disks until they met in a telescope. After eliminating the sources of error, it was found that the images were exactly coincident and that hence no ether had been caught up in the motion of the steel disks.

Perhaps nothing has contributed so much to the possible development of a theory of the ether as the electron theory, which has done so much to reduce phenomena to the inter-play of the electro-static, magnetic, and inductive forces of charged atoms. These forces, together with matter, which may be simply their source in the ether, and gravitation, which is probably an electro-static effect, constitute the whole problem of the ether. The ultimate task is to explain them as the varieties of motion in the fundamental stuff.

To sum up, it is apparent that the problem of the ether, the greatest enigma of all time, cannot be solved by one group or generation or class of scientists. It claims the work of specialists in many fields. While each may see the task from his viewpoint alone, it is worthy of attack from many standpoints. To analyze and classify a nearly infinite variety of phenomena to reach the root-causes of nature, requires the genius of the investigator. To arrange the data in the most logical relationships requires the work of the theorists. To condense and reduce these relations to the simplest and most elegant form the brain of the mathematician is necessary. To appreciate the ultimate signficance of those factors which the others use but as the material of their building, the philosopher is final critic. And to make the results of all the others of interest and value to the human race as a whole, the interpreter must picture them in simplest phrase and most apt illustration.

Do Fishes Hear?

A Summary of Recent Studies

By Dr. Wilhelm Roth

ALTHOUGH Saint Anthony of Padua preached to the fishes, this is no proof that the fishes heard him, for the holy man preached to many "deaf ears." Another ecclesiastical tradition, which has often been cited in evidence of the auditory power of fishes, has likewise failed to stand the test of critical investigation.

The famous old Benedictine cloister of Krems, in Austria, possesses a monumental fish pond, surrounded by stone balustrades and arcades, whose finny denizens have, from time immemorial, been summoned to their meals by acoustic signals—in the old days by beating a drum and in modern times by ringing a hand bell.

Dr. Alois Kreidl, who had previously expressed the opinion that, if the fishes really come in response to the ringing of a bell, they do so because they feel the vibration, not because they hear it, recently visited the monastery in company with Prof. Exner, the well-known Viennese physiologist. The investigators easily proved that the fishes did not hear the sound of the bell, but came to the feeding place only when they saw the attendant ring the bell and throw out the food, or when they felt the vibration communicated to the water by the man's footsteps on the stone run of the pond. When the two observers approached the feeding place in such a manner that the fishes could not see them, hid behind a column and there rang the bell, the fishes did not take the slightest notice of the sound, but when they came to the feeding place in the customary manner of the attendant, without ringing the bell, the fishes quickly swam to the spot. They dispersed immediately on finding that no food was forthcoming, and could not be recalled by ringing the bell.

A similar explanation can be given of many other instances in which fishes are apparently attracted by the sound of the human voice, of bells attached to fishing nets, of drums, and of the clappers which the Japanese employ, in conjunction with torches, in fishing with cormorants. Kreidl and Exner found it impossible to elicit from goldfish any response to whistling, the peal of a large bell, and various other sounds generated in the air, or even to tones produced by drawing a violin bow over metals bars under water. Another experimenter obtained the same negative result with the ear-splitting noise of the toy known as a "cricket."

Even when the reflex irritability of the fishes was greatly increased by dosing them with strychnine, they responded only to sudden and violent sounds, like that of a pistol shot, which caused them to flee in terror. As Langes and Vulpian have found that a pigeon which has been deprived of its brain, and therefore of its sense of hearing, responds to a pistol shot, it appears probable that violent, explosive noises affect the nerves of touch or feeling by means of the concussion of the air, which is transmitted to fishes through the water.

In order to prove decisively whether the reaction, in the case of fishes, is accomplished by any true auditory sensation, or is caused entirely by mechanical stimulation of the tactile nerves, Kreidl experimented with fishes from which the labyrinths of both ears had been removed. These fishes reacted to very loud sounds in precisely the same manner as unaltered fishes, when both had been dosed with strychnine.

Hence there can be little doubt that in fishes the surface of the body has assumed the auditory function, and that a perception of vibrations by the tactile nerves takes the place of a true sense of hearing. It is natural to assume that in fishes the organs of the so-called 'lateral line," which are sensitive to the slightest change in pressure, correspond to the cochlea of higher vertebrates with its Corti's fibers, which parts are entirely absent from the ears of fishes.

We are not justified, however, in assuming that the ears of fishes play no part in the perception of vibrations produced by sound waves, for the otoliths of the labyrinth may serve in fishes, as they do in many other aquatic animals, for the perception of vibration, and may thus assist the organs of the lateral line of the body. It is probable, indeed, that the labyrinth of the ear is only a highly developed and specialized "lateral" organ, and, according to Bonnier, the perception of mechanical vibration is simply the initial stage of the sense of hearing. The difference between the two functions is that in the former the vibrations of pressure are perceived separately, while in the latter they are fused into a single tone, as the mosaic image formed on the retina is seen as a single picture.

Although the fishes that have been studied appear to possess no true sense of hearing, it is not impossible that the ears of some fishes have acquired some slight development. There are many fishes—about 80 species—which produce sounds. In the pairing season some fishes fill the water with noise, which can be heard plainly by an ear pressed to the ship's side. Whether these sounds are produced voluntarily (perhaps to attract the opposite sex) or not, is wholly unknown, but even if some of these musical fishes are found to be sensitive to sounds of moderate intensity, it will still remain probable that they perceive these sounds by a sense of vibration akin to the sense of touch, and do not really hear them.—Translated for the SCIENTIFIC AMERICAN SUPPLEMENT from Umschau.

The Transformation of Sea Water Into Fresh Water

THE belief was prevalent among the savants of the 17th and 18th centuries that a hermetically sealed earthen vessel dipped into the sea would fill itself with fresh water. At the present day it is difficult to say on what this belief was grounded. It surely could not have been evoked by experiment. In a similar sense Marsigli, the founder of oceanology, made in the year 1725 an experiment which effected the filtration of seawater through a system of fifteen pots filled with washed garden-earth or sand and so placed as to let the water fall as if in a cascade. It is stated that the palate disclosed a definite diminution of the presence of salt. Similar assertions are everywhere current among seamen.

A scientific test of the endeavor to free salt from water was recently made by the French investigator Thoulet. His report which appears in the minutes of the Académie des Sciences of Paris states that the presence of salt can be reduced by filtration. Forty centimeters of the length of a glass tube, which was one meter long and was placed in a perpendicular position, was filled with sea-sand, and the rest of the tube was filled with sea-water; portions of the filtrate were examined at intervals of the experiment to ascertain its density and chemical composition. The result was that in the initial stage of the experiment density as well as saline content were found to be moderately reduced; very soon thereafter both recovered their original value. The early decrease of value is explained by the mechanical attraction which every chemically neutral body exercises on the molecules of a substance in solution as soon as the body comes in contact with the solution. In nature, too, sand fails to effect the separation of salt. Through shipwrecked seamen it became known that relatively fresh water may be found on very low and barren coral reefs in the Pacific Ocean by digging to a trifling depth in the coral sand. It is not, however, as was supposed, sea-water freed from salt through the layers of sand, but is simply rain water that is retained by a sandy stratum and by it protected from admixture with the sea-water. Similar phenomena may be observed on the European coasts. They may be considered the key to the popular belief, now contradicted, that sea water can be sweetened by filtration through sand.

Mr. W. Rosenhain, a well-known English metallurgist, in a report of the Advisory Committee for Aeronautics, reviews the results of researches on the alloys of aluminium containing small quantities of other metals so as to leave the density of the alloy very nearly as low as that of the pure metal and yet obtain the increased strength and hardness given to the alloy by such additions. A certain number of these alloys are already in industrial use, namely, those containing Cu, Ni, Zn, and Mg. The mechanical tests of the Cu-Al alloys containing 2.77 and 3.76 per cent of Cu are given, and also the tests of two Cu-Mn-Al alloys containing respectively 2 per cent of Cu and 2 per cent of Mn and 3 per cent of Cu with 1 per cent Mn. The elastic moduli of these latter alloys have been determined and are compared with wood. The elastic modulus of wood is of the order of one-sixth of these alloys. Some tests are given of Al-Ni alloys which appear very promising, but these are said by Guillet to easily corrode. Some details are also given of the Al-Zn alloys. One of the most interesting of the Al alloys is known as wolframium or wolframinium, which contains small quantities of Cu, Sn, Sb, and W. The alloys known as magnalium contain from 3 to 10 per cent Mg, and it is claimed that they are 2 to 2½ times as strong as pure Al. It is pointed out that there is a large field for possible improvement in the range of light alloys to be obtained by the addition of small proportions of heavier elements to Al.

Mixing Concrete on the Farm

How to Select Your Materials and Mix Your Own Concrete

On account of its cheapness, uniformity, and quick development of strength, the only cement practically used at present is the kind called "Portland." There are almost as many brands of Portland cement as there are of wheat flour. For farm work choose some brand guaranteed by the local dealer to meet the standard specifications of the American Society for Testing Materials, which standards are approved by the national government.

Cement takes water so easily that care must be exercised in storing it. Upon the regular floor of a good building place timbers close together, as a support for a false floor, upon which the cement should be piled.

Cement is heavy; do not overload the floor of the building by piling it too high, and do not store it against the side walls. Keep it covered with canvas or roofing paper. Cement once wet sets up and is unfit for use. However, lumps due to pressure in the storehouse must not be mistaken for set-up cement. Such lumps are easily crumbled and may then be used.

Concrete is a mixture of Portland cement and particles of stone. The stone should vary in size from pieces one inch in diameter to sand grains. By so grading the stone, the smaller particles fit in the spaces between the larger pieces, thereby producing the most compact and the strongest mixture.

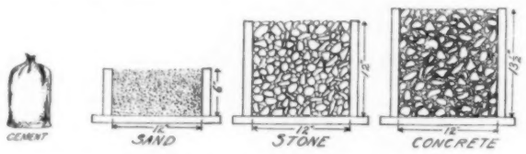
The best stone for crushed rock is one which is clean, hard, and breaks with sharp angles. Trap, granite, and hard limestone are among the best; the use of shale, slate, and soft limestones and sandstones should be avoided. The crushed rock should be screened on a ¼-inch screen to remove the fine particles. These small particles should be considered as sand; and, if insufficient in quantity to make the proper proportion of the concrete, as is described later, enough sand should be added to them to produce the required amount.

Gravel well graded in sizes is at least equally as good for concrete as crushed stone. Bank-run gravel, just as dug from the pit, seldom runs even and rarely has the right proportion of sand and pebbles for making the best concrete. The mixture most suitable has one part sand to two parts gravel, measured by volume, in which all sizes passing through a 1-inch-mesh screen and retained on a ¼-inch screen are considered gravel. As there is usually too much sand for the gravel, it is both advisable and profitable to screen the material and to remix them in the proper proportions. Gravel should have no rotten stone and should be clean, so that the cement may adhere to it tightly.

With dirty sand, no amount of cement will make strong concrete. Generally sand is clean, but if not, it can easily be washed by playing a hose or flushing water upon thin layers of sand placed on a tight-jointed inclined wooden board. In size of grain it should vary uniformly from fine to coarse. All particles passing a ¼-inch screen may be considered sand. Any good-tasting drinking water is suitable for concrete.

For concrete necessarily waterproof..1 : 2 : 4 or 1 : 4
For all other ordinary purposes.....1 : 2½ : 5 or 1 : 5

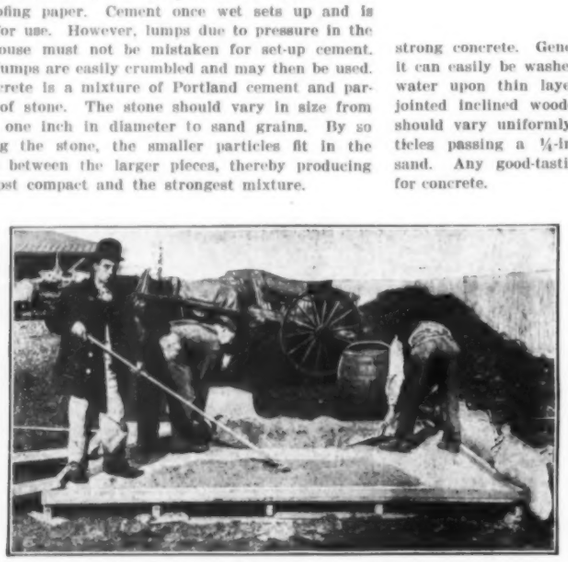
Such proportions of three parts, as 1:2:4, indicate that the concrete is to be mixed 1 part cement to 2 parts sand to 4 parts screened gravel or crushed rock; and 1:4 that it is to be mixed 1 part cement to 4 parts bank-run gravel.



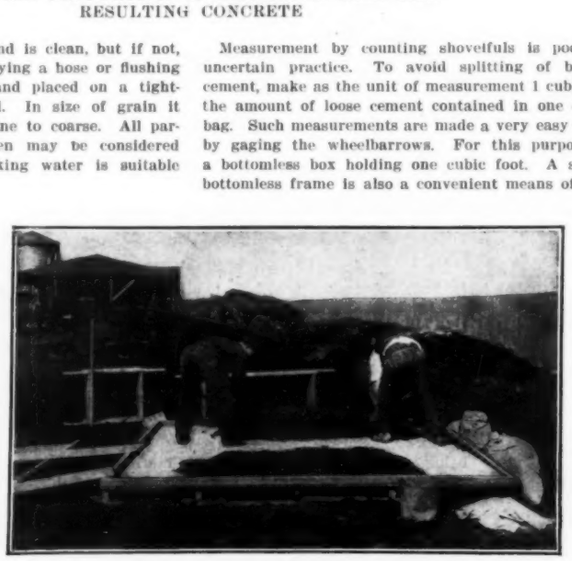
SHOWING PROPORTION OF MATERIALS USED AND RESULTING CONCRETE

Measurement by counting shovelfuls is poor and uncertain practice. To avoid splitting of bags of cement, make as the unit of measurement 1 cubic foot, the amount of loose cement contained in one cement bag. Such measurements are made a very easy matter by gaging the wheelbarrows. For this purpose use a bottomless box holding one cubic foot. A shallow bottomless frame is also a convenient means of measuring. Such a frame, when set on the mixing board and filled, should contain the *full* amount of sand or *one-half* the quantity of gravel, or crushed rock, required for one batch of concrete.

The size of the batch is dependent upon the amount of help and the dimensions of the mixing board or platform. For work of ordinary size, sufficient room will be had on a "two-men board," 8 by 14 feet, framed solidly and covered with one-inch stuff with tight joints the short way of the board. A wooden strip nailed around the outer edges will prevent the loss of liquid cement. For such a board and the proportions designated above, make the bottomless frame of the clear dimensions given in the table below:



VIEW OF MEN SHOVELING AND MAN RAKING CONCRETE



SHOVELING CONCRETE ON A "TWO-MEN BOARD"

The tools and equipment necessary for making concrete in moderate quantities are already at hand on a well-conducted farm, or will be useful afterward for other purposes. The list comprises the following, and is shown in the illustration herewith:

2 square-pointed "paddy" shovels, No. 3.
1 round-pointed tiling shovel or 1 garden spade.
1 heavy garden rake.
1 sprinkling can or bucket or 1 spray nozzle for hose.
1 water barrel or 1 length of hose.
1 sidewalk tamper or home-made wooden tamper.
1 sand screen made of section of ¼-inch wire mesh nailed to a wooden frame.
1 measuring box or frame. See description further along in article.
1 mixing board.
2 wheelbarrows with steel trays.

For farm work the following proportions are most suitable:

CONCRETE MIXING BOARD, TOOLS, ETC

Table for Two-Bag Batch.

Proportions.	Sacks of Cement	Framefuls of Sand.	Framefuls of Crushed Rock or Screened Gravel.	Clear Dimensions of Frame.
1 : 2 : 4 or 1 : 4	2	1*	2	0' 6" × 2' 8" × 3' 0"
1 : 2½ : 5 or 1 : 5*	2	1*	2	0' 6" × 2' 6" × 4' 0"

*For bank-run gravel use the same table, but no sand is required except that which is already in the gravel.

All the materials (slightly more than the computed quantities) should be on hand before beginning the work. They can often be hauled at odd times. The sand and gravel or stone should be piled so as:

To cause the least amount of wheeling.

To make the mixing most convenient to the water supply.

To allow room for the future location of the mixing board.

If the gravel does not need screening, place a bottomless frame, previously described for a 1 : 4 mix, on the mixing board and fill it level with gravel. Lift the frame, spread the gravel slightly with the garden rake, and upon it distribute evenly two bags (the full amount) of cement. Set the frame upon the leveled surface of cement and gravel and again fill it in the same way.

Remove the frame and spread the entire mass by dragging it back and forth with the rake. Two men, opposite each other, then turn the batch with the square pointed shovels. Again use the rake. Keep

turning until the cement no longer shows in streaks, until the mixture has a uniform color. Throw up the ragged edges, and, with sprinkling can or hose with spray nozzle, apply water in quantity, according to special directions obtainable for each particular kind of construction. Turn again and add as much more water as may be required. If dry streaks are still evident, continue the turning until they disappear. With wheelbarrows quickly remove the concrete and immediately use it in the work.

If crushed rock or screened gravel is to be used, fill the bottomless frame with sand and distribute upon it two bags of cement. Drag the materials back and forth with the garden rake, then turn, as described above, until the mass has a uniform color. Spread the mixture so that two framefuls of crushed rock or screened gravel may be placed upon it. Wet the mass and turn as for bank-run gravel until each stone is coated with cement mortar. Remove as for the gravel concrete.

For the proportion of 1 : 2½ : 5 or 1 : 5 the method of mixing is the same.

Since crushed stone is more or less porous, in dry hot weather it is advisable to keep the stone pile wet or at least to water the stone well as it stands on wheelbarrows ready for the mixing board.

No vast amount of knowledge and experience is necessary to do first-class work in concrete. Success is dependent upon the care and thoroughness exercised in the

Selection of the materials,
Mixing of these ingredients, and
Protection of the freshly placed concrete.

The Mathematical Initiator

A Tangible Multiplication Table

A FEW years ago a French gentleman named Camescasse constructed, for the edification of his children, a tangible multiplication table, with the aid of the one-inch cubes of the Froebel kindergarten material. He has recently improved this apparatus for teaching the rudiments of mathematics by using cubes with deep grooves on two opposite sides and at right angles to each other, into which can be inserted straight bands of metal, which fit the grooves tightly enough to hold a row of blocks together, but not too tightly to be easily removed.

The improved apparatus, which is sold under the name of "the mathematical initiator," consists of 600 white blocks, 600 red blocks, and 144 metal bands of various lengths. The blocks measure a trifle less than one centimeter every way, so that a row of 10 blocks, with the inevitable narrow interstices between them, measures 10 centimeters, very approximately. The grooves are 5 millimeters deep and 0.8 millimeter wide, and the longest metal bands are 4 millimeters wide, 0.8 millimeter thick, and 92 millimeters long. Hence a band which binds ten blocks together is completely buried in them and the blocks form a smooth

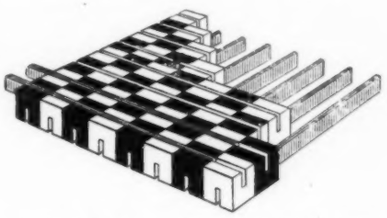


Fig. 1.—Method of assembling the blocks by means of metal bands

square bar, one decimeter in length. By inserting bands in the other set of grooves, ten of these composite bars can be joined together to form a plate, one decimeter square, as is shown in Fig. 1.

The mathematical initiator will be found useful in forming the designs and patterns which constitute a regular part of kindergarten work. Fig. 2 shows one of the vast number of patterns that can be formed of

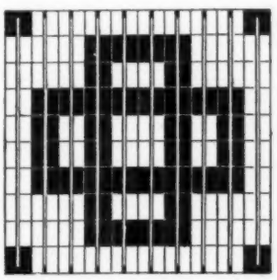


Fig. 2.—A mosaic pattern

the red and white blocks, assembled by means of the metal bands. By handling the blocks, children are unconsciously initiated into the mysteries of arithmetic and learn to count with hands and eyes before they can name or write the numerals. A young child is soon taught to affix to each metal band one block for each of its ten fingers, and the count can be verified by placing the fingers on the assembled blocks, as on the keys of a piano. Afterward the child learns to count the blocks and the bars of ten blocks. Ten bars of 10 can be assembled into a plate of 100 by inserting metal bands into two of the vacant grooves, and 10 plates can be piled up to form a cube of 1,000 blocks, or one cubic decimeter. In this way the child requires an objective knowledge of units, tens, and hundreds, and learns that a thousand represents 10 hundreds or 100 tens. At the same time a familiarity with the metric system is acquired. The child soon adopts the square centimeter as the unit of area and the cubic centimeter as the unit of volume, and learns that a decimeter contains 10 centimeters, a square decimeter contains 100 square centimeters, and a cubic decimeter contains 1,000 cubic centimeters.

More abstruse arithmetical operations can also be materialized with the aid of the mathematical initiator. Among such operations are those which give the sum of n consecutive whole numbers, the square of the sum or difference of two numbers, etc. Fig. 3 shows a square of red and white blocks arranged to illustrate the formula $(a + b + c)^2 = a^2 + b^2 + c^2 + 2ab + 2ac + 2bc$, that is, the law that the square of the sum of three numbers is obtained by adding the sum of the squares of the numbers to twice the sum of their products, taken two and two. In the example illustrated the numbers are 2, 3, and 5, the sum of which is ten. A little inspection of Fig. 3 shows that the large square, having 10 blocks on a side, is made up of three smaller squares, having respectively 2, 3, and 5 on a side, and of three pairs of rectangles of 2 by 3, 2 by 5, and 3 by 5, but this fact is impressed on the

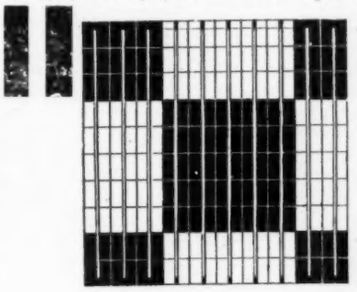


Fig. 3.—Demonstration of formula $(a + b + c)^2 = a^2 + b^2 + c^2 + 2ab + 2ac + 2bc$

child's mind far more firmly, and in concrete form, in the process of building up the large square. The above are only a few of the educational possibilities of the mathematical initiator.—Revue des Sciences.

Problems of Existence

By SIR OLIVER LODGE.

IN the first of a series of three lectures just delivered on "Problems of Existence," Sir Oliver Lodge said that the term science might be used in a narrow or in a broad signification. Sometimes the one was convenient, but always the other was permissible; and, if the use of the term in the narrow sense tended to obscure the larger significance, then, in that connection, such use must be deprecated. It was rather commonly supposed that the region amenable to strictly scientific study was a narrow one, and that it by no means embraced, nor would it ever embrace, the whole of possible knowledge. A boundary was often drawn between the scientific arena, on the one hand, and the literary, the philosophic, the religious domains, on the other. But, in truth, no such boundary could be drawn; there were no absolute barriers or discontinuities in nature. Every subject merged into, and had more or less connection with every other. It was true that subjects were in very different stages of maturity; more exact and precise knowledge was attainable in some of them than in others. Those subjects which, in a given epoch of the world's history, were susceptible of exact and demonstrative treatment—especially those which were amenable to the alternate analysis and synthesis of the Newtonian method—constituted the citadel of the scientific domain. But there were also sciences which, as yet, were almost wholly in the stages of observation and classification, and any one of these might develop sooner or later into something more like the deductive stage; as chemistry had within the last century—not only new compounds, but even new elements being predicted—and as biology had begun to show signs of doing under the stimulus supplied by the genius of Darwin and of Mendel. There could be no doubt that this tendency toward advance from the vague to the definite was a constantly progressive one, and that departments of human experience now apparently beyond treatment by rigorous methods would gradually be incorporated and fused in the conquered and explored territory. Meanwhile they were not shut off from human scrutiny merely because rigid treatment was not yet applicable. They must be treated by methods appropriate to the stage to which our minds had risen with respect to them. No contempt for such methods should be felt, except when they were applied in departments wherein they had already been superseded.

Some there were who regarded the scientific advance, or, as they called it, encroachment upon wild and unexplored territory, with dislike, thinking that the process would be death to mystery, and would reduce all nature to matter-of-fact and commonplace. In geography it must to some extent be so, since the surface of the earth was limited. But those who realized the infinitude of complexity in the simplest existence, and the way in which the whole of creation was bound together without barriers or boundaries or limitations, forming one continuous and infinite whole, would have no such fear; nor would they think it inappropriate for a scientific man to cast his eyes around, from time to time, to see what new departments of knowledge might be coming within his ken. Indeed, they would not hesitate to welcome such advances, and reach out a hand to catch as best they might some anticipation of the interest that must thus legitimately accrue to the accumulated wealth of knowledge now within our grasp.

THE PROBLEM OF EVIL.

The narrow specializing attitude was useful, and had performed yeoman service. The work of the delver and digger was of the utmost value; but they must not, through use and wont, gradually acquire the notion that theirs was the only method of value, or that the work of the humanist, the inspired gleams of the poet, the guides available through the intuition and instincts of humanity, were deceitful will-o'-the-wisps which led to nothing. There was room for every class of worker; and the men of science themselves might in certain moods raise themselves out of their groove of steady work and look around, as one and another had always done, and tell the world what it was they saw from their point of vantage—whatever that point of vantage might be, whether elevated peak or subterranean cavern. For, however it might be regarded by others, still it was their point of view, the place they had attained through severe toil; and it was not only their right, but their duty, to tell such other workers as would listen what it was that thence they saw.

Sir Oliver elaborated a reasoned foundation for an optimistic attitude toward the Universe; dealing with the Problem of Evil as illuminated, and, to some extent, solved by the relativity of all things. He instanced the analogy of light and shade in an engraving, and pointed out how meaningless and monotonous existence would be if it were all high light. He considered that pessimism, if encouraged, led to a kind of practical atheism, and that this attitude was quite unnecessary and illogical. In his treatment of evil he discriminated, however, between the theological problem of evil in the abstract, and the human problem of sin or man-made evil, and insisted that an explanation of the one formed not the slightest justification for the other, though by casual readers and speakers the two aspects were sometimes confused.—English Mechanic and World of Science.

Marconi's Marvels Explained in a London Law Court

Messages Received in Court from Ships at Sea

By P. F. Mottelay

On Monday, the 12th of December, was commenced, in the Chancery Division at the London Law Courts, before Mr. Justice Parker, one of the most interesting suits on record, also likely to prove one of the most costly, by reason of the large number of eminent counsel employed as well as of the many expert witnesses to be called, and of the long time it will necessarily require to properly bring before the court all the claims of the litigants.

The action is brought by Mr. G. Marconi and his companies against the British Radio Telegraph and Telephone Company, for the alleged infringement of three patents dated 1900, 1902, and 1907. Representing the plaintiffs are Mr. Astbury, K.C., Mr. A. J. Walter, K.C., and Mr. J. H. Gray. For the defendants are Mr. T. Terrell, K.C., and Mr. Colefax. All the lawyers employed are well specialized in patent law.

The wireless system is to be worked in court by means of the Law Courts' electric current, which has been tapped by leave of the Office of Works under the supervision of Prof. Boys. A wire attached to the complicated machinery passes through one of the windows, and connects with an aerial wire fixed to the clock tower. It is said that messages will be interchanged with stations at Gibraltar, in the Mediterranean, and elsewhere, and with ships in the English Channel. Some messages had already been picked up over London when the apparatus was set up, the previous Saturday.

The whole of the first day was devoted to Mr. Astbury's opening speech, which was not concluded until middle of the day following. He explained that his address would be divided into four parts, in an endeavor:

1. To show what Mr. Marconi had done apart from scientific theories.

2. To put the court into possession of the scientific theories connected with this very difficult system, and explain what was scientifically known before granting the patent of "the four sevens."

3. To explain the "four sevens" patent.

4. To deal with the question of infringement.

He then gave a short sketch of the history of wireless telegraphy, describing the "first beginnings of knowledge," and traced the results which were obtained by Heinrich Hertz, "the great founder of the whole theory upon which the system has been built up," and mentioned the fact that Sir William Crookes was the first who suggested the possibility of using Hertzian waves for the purpose of transmitting messages. This he did in a "Fortnightly" article published during 1892. Two years later (1894) Sir Oliver Lodge gave a lecture at the Royal Institution of Great Britain, which was by many relied upon as an anticipation of Mr. Marconi's 1900 patent, but erroneously, said he, for Lodge made no satisfactory suggestion as to how the Hertzian waves could be put into practical use; he had deflected a galvanometer needle from the distance of a few yards, and all that he had really demonstrated was the existence of the ether waves.

During 1896, Mr. Marconi took out the first patent ever granted on wireless telegraphy. He made numerous trials, and succeeded in transmitting messages in Italy, a distance of 1½ miles, and, on Salisbury Plain, in presence of many British officials, as far as 1¾ miles. In the following year, at the last-named place, he sent messages first 4 miles, then 8 miles, across the Bristol Channel, subsequently increasing the distance to 12 and to 14-15 miles, and finally covering 30 miles during the year 1899. The year before (1898) the wireless system had been installed between Osborne and the royal yacht, thus enabling Queen Victoria to maintain constant communication with the then Prince of Wales (King Edward VII.). In 1899 the system was fitted on three English battleships, and was sent out to the Boer battlefields as well as to the Sandwich Islands. In 1900 wireless was adopted by the Norddeutscher-Lloyd Steamship Company and installed on one of their largest vessels. In 1901 the Admiralty obtained a license for the use of wireless telegraphy from the plaintiff company, which had, four years previously, been registered to take over and work Mr. Marconi's patents in Great Britain. It was in this same year (1901) that the wireless was accepted by the Canadian government, and that the first message was transmitted from Poldhu in Cornwall to Newfoundland, some 1,800 miles, which distance was increased the year after to more than 2,000 miles. In 1903 an International Conference was held in Berlin, at which England was represented, but, in consequence of England's relations with the Marconi Company, that country could not assent to certain definite propositions put forward by the other nationalities.

During 1904, the Wireless Telegraphy Act was passed, mainly to enable the making of international agreements. It prohibited the installment of the system in the United Kingdom or on British ships without the license of the Postmaster-General, and specified that the apparatus must be of the character described in the agreement, that it must be syntonized in all British vessels, that it must be so constructed as to be capable of using wave lengths of 300 meters—so as not to interfere with the longer wave used by warships—and that the speed limit should not be less than twelve words a minute. In the same year, 1904, the Russian government ordered the wireless for its own purposes, and used it throughout the war with Japan.

Every important land station in the United Kingdom, except one in Galway and one in Cornwall belonging to the Post Office, had meanwhile been prepared for the reception of the system, and during the year 1905 an arrangement was made by which the Board of Trade and the Corporation of Trinity House fitted lightships with wireless installations for the purpose of protecting the coasts. By a later agreement, it was arranged that the Post Office should acquire the land stations then being erected in order to prepare them for the transmission and reception of wireless messages. At the present time, every English battleship is fitted with the Marconi system, and not long since a message was transmitted to England from South Africa, a distance of 6,000 miles.

Mr. Astbury explained how in the first half of the last century, phenomena relating to electricity were observed and gradually understood until, in the fifties, Joseph Henry first evolved the theory of oscillatory discharge of electricity, which was proven by Lord Kelvin; then how Clerk Maxwell had evolved from the discovery of oscillation the newer theory that oscillatory discharges of electricity must be accompanied by wave disturbances in the ether, which theory, he showed, was satisfactorily proven by Hertz and others. Tesla, he said, was the first man who drew attention to the utilization of air waves, and he then explained Lamby's invention of the coherer, by which the waves were controlled and measured, and he also reviewed all other improvements made up to the present time.

By way of illustrating the principle of "the four sevens" patent (No. 7,777) of 1900, Mr. Astbury said that if you kept on giving a pendulum little touches with a feather, you gradually get it to take long swings. In the same way little waves were seen pattering up against the "four sevens" receiver. When their combined efforts reached the point to which it was tuned, the messages were read. By this device messages got to their intended destination and nowhere else.

With regard to the infringement, Mr. Astbury argued at great length how the defendants had imitated Mr. Marconi's patented apparatus, with the exception of the unimportant transformer, by employing the same persistent oscillator, the same aerial, and the same primary in a closed circuit. He alleged that the defendants had copied Mr. Marconi in everything they had done.

In conclusion, Mr. Astbury stated that the two great problems Mr. Marconi had had to face were:

1. How to improve his apparatus so that each receiving station should respond solely to the waves from one particular transmitter or set of transmitters.

2. How to increase the efficiency of his apparatus so as to cover great distances.

The Origin of Bulldogs and Pugs

The history of most of our domestic animals is shrouded in mystery. The breeders of former times did not realize the importance of keeping records of their methods and results; or they were too ignorant to understand just what they were doing, getting results for the most part through an occasional lucky hit amidst many routine misses.

A German investigator attempts to work out the history of the bulldog and of the pugdog by studying the pedigrees of dogs, goats, pigs, and cattle that showed the characteristic shortening of the skull that distinguishes these breeds of dogs. After considerable comparative study of the skulls of these mammals he concludes that inbreeding is the cause of these peculiar head-formations.

This view is severely criticized by biologists, since it is a well-known law that inbreeding never creates new characters, but only intensifies old ones. A more reasonable view is that which directs attention to the fact that many wild animals, when caught young and brought up in confinement, do not have as long heads as shown by other members of the species in the wild state. A decided shortening of the bones of the face takes place in the case of the wild dogs and the wolf. This is the beginning of the pug face. Inbreeding develops this character; it is the *method*, not the *cause*, says Prof. Hilzheimer, of Stuttgart. This scientist finds the cause rather in the modified use of the jars resulting from conditions of captivity. The face, he says, fails to develop the same as it would in a state of nature.

The bending of the bones of the palate in these dogs is explained by the upholder of the inbreeding theory as resulting from degeneration or rachitis ("rickets") due to the inbreeding; Prof. Hilzheimer explains this bending as due to the crowding of the teeth consequent upon the shortening of the face bones.

While it is true that inbreeding can not cause the appearance of a new character, it is also true that we have no evidence of any character arising as a result of changed external conditions being preserved by heredity. If it is true that changes in the food have made the jaws of wild dogs under domestication fall to development, we should be able to get the original wild dog again by suitable feeding; this however is impossible. According to our present knowledge, the probabilities are that short-faced dogs, like short-faced varieties of other animals, arose as "sports" and were preserved through inbreeding, or even had the character intensified.

The Diseases of Tea

THE cultivation of the plant is making considerable progress in the Caucasus region, and although its introduction has been comparatively recent, it has already brought a good profit to the planters. However, the tea plant is subject to maladies caused by certain parasites which prevail in these regions. A Russian scientist, M. Spiechneff, observed twelve cryptograms, and one of them, the *Pestalozzia guepini*, causes a curious disease known as the "gray malady." Here the leaves show gray spots surrounded with a border of darker color. After some time there appear small dark spots which represent the fructification of the fungi. Other dangerous species are the *Dicosia Theae* and the *Capnodium footii*. This latter causes a malady known as "soot" of the tea plant, and sometimes gives much damage. Another disease is described by M. Spiechneff, and it has the form of buff-gray spots sometimes covering all the leaves. He considers that it is caused by a cryptogram, but Duconnet and others consider that the disease is not of a parasitary nature. The gray malady and the "soot" disease attack also the leaves of evergreen plants such as the camelia, rhododendron, and magnolia, but on the contrary the former hardly ever attacks any but the Chinese tea plant, and others escape it. We may also mention that M. Voronoff observed in the Imperial plantations near Batoum, a caterpillar which bores galleries in the young tea shoots and causes much damage in this way.

A Berlin inventor has recently designed a simple device for the felling of trees. The trunks are cut by the friction of a steel wire about 1 millimeter in diameter, which, as demonstrated by practical tests, is able to cut through a tree about 20 inches (50 centimeters) in thickness in six minutes. The wire, which is carried to and fro by an electric motor, is heated by friction on the tree to such an extent as to burn through the timber, the result being a cut which is both smoother and cleaner than that effected by saw. The wire will work satisfactorily on the thickest trees without the insertion of wedges into the cut, and the trees may be cut immediately above or below the ground. In the latter case the stump may be left safely in the soil. The motor which actuates the wire is placed outside of the range effected by the fall of the tree, and when electricity is not already available it can be generated by a transportable power plant consisting of a 10-horse-power petrol motor and dynamo, which are left at the entrance to the forest during the felling operations.

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Gypsum block making machine, W. M. Cowley ... 980,144
Hair pin, A. Burke ... 979,422
Hammer, power, A. Malaurie ... 979,522
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Hammock, hanging seat, I. E. Palmer..... 980,166
Hammock, knockdown couch, I. E. Palmer. 980,167
Hammock suspension means, I. E. Palmer. 980,170
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Harvester, cotton, O. C. Houghton ... 979,850
Hat fastener, J. Tauss ... 980,021
Hat hook, E. L. Meyer ... 980,162
Hat indicator, C. W. Rozell ... 979,707
Hay elevators, rope supporting device for, C. A. Hanson ... 979,665
Hay loader, J. Hadley ... 979,846
Headlight screen, S. Jones ... 979,508
Heat of compressors, utilizing waste, F. Shuman ... 979,579
Heater, J. S. McCarthy ... 979,527
Heating device, hot water, M. F. Bishop... 979,415
Heel for shoes, exchangeable, S. Stromer. 979,593
Heel for boots, etc., H. Fenton ... 980,085
Hexamethylene tetramin monoguaiacol, Barell & Elger ... 979,916
Hexamethylene tetramin diguaiacol, Barell & Elger ... 979,917
Hog trap, H. M. Sheesley ... 980,015
Hoisting device, J. Owen ... 979,691
Honeycomb foundation, O. M. Husted...... 979,765
Hoof protector, A. J. Gastlin ... 980,094
Hook, H. C. Brown ... 979,926
Horse detacher, P. C. Day ... 980,074
Horse overshoe, W. H. Trabue ... 979,602
Horseshoe, O. E. Dyson ... 979,450
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Hose construction, C. M. C. Baird ... 979,408
Hose coupling, E. J. Hannold ... 979,481
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Hot water storage, system of, R. V. Jones. 979,507
Hydrant and valve therefor, J. L. Fuller... 979,941
Hydraulic motor, W. C. Kelly ... 979,511
Ice cream freezer, W. C. Broadwell ... 979,823
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Index, M. Co[illegible] ... 979,437
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Inkstand, F. [illegible] ... 979,473
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Instep support, W. F. [illegible] ... 979,930
Insulator base, W. T. Goddard ... [illegible]
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Lamp socket, electric, Chandler & Fleet... 979,428
Lamp socket, incandescent electric, S. B. Van Ranst ... 979,608
Lamp sockets, switch operating device for, H. E. Plunkett ... 979,693
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Lamp wire connection, electrical, S. Ashdown ... 979,636
Lamps, heater and glower renewal for second class conductor, O. Foell ... 979,455
Lamps, pull socket for electric, G. W. Goodridge ... 979,475
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Legging, M. Rosenwasser ... 979,702
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Line threading machine, F. N. Steigleder.. 979,899
Liquid actuating apparatus, R. Conrader.... 979,746
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Loading machine, T. Malloy ... 979,778
Lock, A. Colosimo ... 979,825
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Lubricating cups, locking device for, K. M. Anderson ... 980,043
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Magnet, lifting, A. C. Eastwood ... 979,750
Magnetic materials from other materials or from liquids, apparatus for separating, A. E. Davis ... 979,934
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Mail bag catching and delivering apparatus, I. P. Tidmore ... 979,723
Mail box support, H. C. Rogers ... 979,565
Mail catching and delivering apparatus, W. Stetsall ... 979,587
Malt beverages, manufacture of, R. Wahl... 979,810
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Mast, portable, extensible, and retractable, Jaeger & Siewert ... 980,157
Match box manufacturing machine, G. Olsson ... 980,120
Match lighter, E. Zeschmar ... 979,632
Mausoleum, M. L. Knight ... 979,965
Measure, tailor's, J. E. Little ... 979,866
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Mining machine, S. J. Teller ... 979,597
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Music leaf turner, Gibson & Sartolou..... 979,942
Music stand, A. Wolff ... 979,626
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Net, straw hoisting, G. Glaser ... 980,096
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Nut lock, L. K. Watrous ... 980,034
Oil distributing apparatus, C. P. Price ... 980,002
Oil of wintergreen, menthylated, G. Bleberger ... 979,416
Oil or other viscous liquids, apparatus for heating or cooling, J. G. Weir ... 979,618
Oil, paint, E. Gossett ... 979,662
Oil pot indicator, A. R. Pritchard ... 979,799
Ore concentration apparatus, T. J. Hoover. 979,857
Ore dressing, flotation tank for, S. K. Behrend ... 979,820
Ore furnace, C. J. Best ... 979,921
Oven, W. J. Best ... 979,413
Oxids, obtaining solutions or quasi solutions of certain metallic, Z. Cartwright..... 980,143
Painting machine, dip, Vallone & Rogers .. 980,030
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Paper pulp refining apparatus, J. L. Perkins, et al ... 979,885
Paper receptacle or box, C. O. Mason ... 979,871
Parasol bag, H. K. Hansen ... 980,098
Pasteurizer, B. D. Pinkney ... 979,796
Pasteuring apparatus, E. Davron ... 979,830
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Pen, fountain, G. H. Carter ... 979,427
Pen, fountain, J. L. Goldsmith ... 979,757
Pen holder, finger guard, J. Roecker, Jr.... 979,801
Pen, stylographic, J. Ullrich ... 979,606
Pencil, sharpener, D. F. Oliver ... 979,688
Phonograph disk record cabinet, E. & D. C. Pooler ... 980,124
Photographer's tray, W. Holtze.............. 979,858
Piano action, I. Worzina ... 979,729
Piano player, automatic, C. E. Gittins ... 979,470
Piano player, electric, W. H. Smith ... 979,715
Piano players, automatic adjustable spool for music sheets for mechanical, H. G. Miller ... 979,536
Pinning machine, S. E. Greenberg ... 979,758
Pipe bending machine, Tucker & Oechsle.... 979,724
Pipe coupling, H. Mueller ... 980,116
Pipe coupling, train, J. & C. E. Sullivan.. 980,135
Pipe cutting machine, C. A. Olson ... 979,551
Pipe joint, flexible, J. Koenig ... 979,513
Pipe mouthpiece, multiple jet, C. Kunzelmann, Sr. ... 979,771
Pipe reamer, P. Neerup ... 979,786
Piping, heat exchange, G. Hildebrandt ... 979,762
Placket openings in undergarments, machine for trimming and cutting, A. H. Morrison ... 979,684
Planter and disk coupling attachment, J. B. Allbee ... 979,417
Pliers and wire cutter, P. Bondbooks ... 979,[illegible]
Plow attachment, H. E. Davis ... 979,829
Plow, rotary disk, G. H. McKee ... 980,113
Plumes and similar articles, holder for, W. W. Mock ... 979,[illegible]
Polygon inscriber, R. Dworsky ... [illegible]
Pool and billiard table, combination, J. Ryner ... 980,142
Posts, ball cap for binder, Shoemaker & Holland ... 979,713
Potato digging machine, O. H. Claflin ... 979,432
Poultry fountain, H. E. Bryan ... 979,420
Power generator, internal combustion, A. Pelletier ... 979,554
Power press attachment, J. G. & H. L. Renster ... 980,[illegible]
Power transmission device, V. G. Apple... 980,044
Power transmission mechanism, J. O. Michaud ... 979,534
Press gripper mechanism, cylinder, H. P. Guillo ... 979,845
Pressure to tanks and other appliances, apparatus for controlling the admission and relief of, Priestman & Moore.... 979,608
Printing machine line unit case, W. A. Sorg ... 979,586
Printing plates, producing letterpress planographic, A. L. Saltzman ... 979,890
Printing press, G. E. Pancoast ... 979,791
Printing press, single plate rotary, H. F. Bechman ... 979,919
Projectile, O'Byrne & Flood ... 979,993
Projectile for ordnance, E. Schneider....... 979,575
Propeller, I. A. Hortman ... 979,672
Pull out bracket, F. Herkert, Jr. ... 979,949
Pulley, W. N. Mecklan ... 979,873
Pulley back, G. C. Sandmyre ... 980,010
Pulley, sash cord, H. G. Voight ... 980,031
Pump, B. Black ... 980,050
Pump liner, steam, H. G. Johnston ... 979,960
Pump, rotary, N. W. Akimoff ... 979,634
Pumping apparatus, S. F. Aaron ... 979,633
Putty knife, E. E. Koschke ... 980,177
Radial drill, J. G. Dornbirer ... 979,749
Radiator, F. C. Birch ... 979,414
Rail bond, R. L. Dunivant ... 979,448
Rail clamp, guard, G. L. Hall ... 979,477
Rail joint, G. L. Hall ... 979,478
Rail joint, T. A. Chapman ... 980,065
Rail, transporter, F. J. Gilman ... 979,469
Railway brake, electric, J. N. Mahoney .. 979,868
Railway braking apparatus, pleasure, J. A. Miller ... 979,983
Railway crossing, H. G. Elfborg ... 979,479
Railway rail and nut lock for fish plate bolts, A. P. Finley ... 980,146
Railway safety device, pleasure, J. A. Miller 979,984
Railway safety track, C. R. Howard ... 979,494
Railway starting apparatus, pleasure, J. A. Miller ... 979,875
Railway tie, W. H. Morris ... 979,785
Railway tie, W. T. Shimp ... 980,016
Railway tie and fastener, metallic, C. J. Burch ... 980,058
Railway ties, collar for concrete, J. S. Warrick ... 979,615
Railway track rail holder and brace, J. T. West ... 980,036
Ramming machine, J. K. Dimmick ... 979,839
Razor attachment, E. P. Truesdale ... 980,027
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Reamer, adjustable, A. Studer ... 979,809
Receptacle, C. L. Sanford ... 979,803
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Refrigerator, F. Westerbeck 979,814
Refrigerator, W. H. Hill 979,950
Regenerative furnace, A. W. & C. W. Catton 979,647
Ribbon holding device, M. L. Ford 979,456
Riddle, E. H. Mumford 979,885
Riveting tool, pneumatic, C. Weatherson 979,917
Roof structure, ginael, H. T. Thomas 979,660
Roofing material fastener, R. S. Ford 980,080
Rope joint, A. Rosenthal 979,567
Rotary engine, G. E. Ball 979,638
Rotary engine, H. Doke 980,075
Rubber footwear, M. C. Clark 980,173
Rubber, recovery of, H. T. G. Van der Linde 979,962
Sad iron, W. W. Lind 979,520
Safety device, G. W. Markle 979,978
Safety gate, G. R. Freak 979,458
Salt shaker, S. P. Isbell 979,509
Sand blast, closed hopper, G. F. Steedman 979,969
Santalol compound, R. Berendes 979,639
Sash fastener, G. I. D. Johnson 979,504
Sash lock, W. A. Jordan 979,801
Sash lock, metal window, F. F. Smith 979,582
Sash or window lock, W. E. Pelar 979,884
Sash, reversible window, E. L. Reguin 980,085
Sash, window, A. P. Burkhart 979,423
Sash, window, P. W. Bowde 979,741
Saw clamp, R. J. Koeberle 979,967
Saw filing machine, H. Seifert 979,892
Saw, pruning, J. S. Bennett 979,920
Scale, automatic weighing, McKeown & Kirkpatrick 980,114
Scale, machinist's, M. F. Jones 979,708
Scale, spring, G. Walker 979,611
Sealing, annealing, and coating metals, S. O. Cowper-Cowles 979,931
Screen bed, A. O. S. Jones 979,506
Screw driver, etc., ratchet mechanism for, W. B. Lane 979,862
Screw, jack, E. M. Burney 979,424
Scrubbing machine, A. Leigh 979,775
Seal, freight car, G. Ba-Edgar, Sr. 979,852
Sealing device, electric, J. G. Wallmann 979,905
Seat post, spring, W. S. Harley 979,483
Sectional boiler, J. B. Bernhard 979,736
Sectional boiler, double, J. B. Bernhard 979,738
Selecting device, F. G. Agrell 979,404
Separation, process of, H. A. Wentworth 980,035
Sewing machine, G. M. Esmes 979,451
Sewing machine, J. C. Moore 979,537
Shade holder, Handel & Teich 979,904
Shade holder, W. H. Perkins 979,793
Shade roller support, window, E. O. Engberg 979,752
Shaft, flexible, S. C. Moorhead 979,585
Shaft shifter, J. T. Emmerson 979,751
Shafts and the like, apparatus for centering, G. Williamson 979,909
Shafts, machine for forming heel irons for vehicle, G. A. Lambert 979,517
Sharpener, disk, H. L. Depew 979,831
Sharpening machine, blade, F. P. Olds 979,879
Shaving appliance, E. Praeger 979,696
Sheet feeding apparatus, F. J. Brasseur 979,822
Sheet feeding mechanism, E. & E. K. Norton 979,540
Sheet inserter, E. W. Edgerton 980,081
Sheet metal can, F. Westerbeck 979,813
Shock lifter, A. N. Hadley, reissue 13,187
Shock loader for grain and hay, B. F. Wilson 980,038
Shoe polishing stand, F. H. G. Morse 979,543
Shoe stretcher, D. P. Rowland 979,705
Shutter operating and fastening device, G. W. Adams 979,940
Shuttle, T. J. Garisio 980,093
Shuttle threading means, H. L. Litchfield 979,865
Sign controlling appliance, Hurer & Dilks 979,856
Signaling box, electric, A. Kempston 979,769
Silo, A. E. De Armond 979,444
Silo, N. Johnson 979,767
Skate, D. M. Pfautz 979,795
Skirt gage, Hogan & McCormick 979,492
Sluicing machine, centrifugal, A. Ponten 980,001
Smoking implement, J. M. Eder 980,080
Snap hook, A. W. Brash 979,641
Snuff box, trick, T. Hummel 979,499
Sodium, means for the electrolytic manufacture of, P. L. Hulin 979,497
Soldering iron, electric, A. H. & C. P. Wagge 979,904
Soldering iron heater, Burger & Sakren 980,059
Soldering tool, R. Staehle 979,896
Squares, pitch gage attachment for, J. Parkhill 979,906
Stacker attachment, C. Langom 979,677
Stacker attachment, pneumatic, D. Bergman 979,412
Stamp, hand, J. A. Schmits 980,072
Stanchion, C. H. Moore 980,163
Stay bolt drill, H. L. Barrickman 980,139
Steam condensing apparatus, D. B. Morison 979,540
Steam engine, vacuum, C. Comstock 979,435
Steam superheater, J. C. Hall 979,609
Steam traps, demonstrating apparatus for, C. E. Squires 979,716
Steering device, H. E. Bayly 979,411
Steering means for vessels, Hertzberg & Wahl 980,156
Step, platform, and door operating mechanism, C. W. Ragland 979,886
Sterilization of water or other liquids, apparatus for the C. Comstock 979,900
Stoker, automatic, W. T. Hanna 979,849, 979,850
Stove, blue flame oil, C. S. Cannon 979,646
String clasp, S. Stewart 979,588
Structure, reinforced, D. B. Luten 979,776
Structure, trussed, P. B. Harrison 980,090
Studding for plaster boards, H. H. Burson. 979,643
Surfacing machine, A. Bevan 979,739
Surgical instrument, H. Johnson 979,505
Surveying and like purposes, instrument for, E. H. V. Merrill 979,531
Suspender attachment, W. D. Flynn 979,858
Suspenders, Hayden & Gordon 979,947
Swage, casing, R. W. Eames 980,079
Swing, G. Simon 979,581
Switch, A. Gering 980,150
Switching system, O. T. Lademan 979,676
Telegraph apparatus, J. B. Odell 980,118
Telephone call recorder, H. N. Sandell, Jr. 979,569, 979,570
Telephone mouthpiece, Gibberd & Elias 979,467
Telephone receiver, Thompson & Stuart 980,024
Telephone relay or repeater, H. Morgan 979,986
Telephone switchboard key, E. Wesman 979,916
Telephone system, S. S. Stolp 979,590
Telephone transmitter, C. Adams Randall 980,042
Temperatures, generating high, W. C. Finck 980,087
Threads, apparatus for use in the manufacture of artificial silk and like, J. Clayton 979,434
Tile, furnace, G. W. Wood 979,627
Time recorder, J. Sokoloy 979,585
Tire, J. J. Patton 979,882, 979,883
Tire for vehicle, elastic, A. Boerner 979,417
Tire, non-skid, R. H. Keaton 979,961
Tire patching device, G. J. Martel 979,525
Tire shoe vulcanizing apparatus, R. Rowley. 979,889
Tire shoe wrapping and vulcanizing apparatus, R. Rowley 979,508
Tires, puncture guard for pneumatic, T. H. Prince 979,699
Tobacco moistener, R. Rashe 980,127
Toggle bolt, J. E. Goewey 979,841
Tool, adjustable, P. F. Connelly 980,067
Tool driver, spiral, Pegley & Leopold 979,939
Tool rest, F. E. Olds 979,880
Torpedo placer, E. P. S. Andrews 980,137
Torsiometer, electrical, C. H. Johnson 979,503
Toy, A. Schwenhut 979,486
Toy, A. Schwenhut 980,013
Trace coupling, A. Bulley 979,743
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Trocha cutter, Nelson & Bean 979,668
Trolley guard and finder, H. R. Sherman... 979,712
Trolley stand, C. M. Feist 979,940
Trouser legs, means for creasing, D. Marinsky 979,790
Trucks, adjustable journal box for, S. M. Chase 979,648
Trunk hasp, C. J. Lynaght 979,777
Turbine, T. J. Westerman 979,619
Turbine, A. W. Bennett 979,735
Turbine controller, H. G. Sahlin 979,902
Tweezers, C. J. Prankard, Jr. 979,697
Type casting and composing machine, Link & Morgan 979,864
Typewriter ribbon movement, G. A. Smith.. 979,583
Typewriting machine, H. M. Hamilton..... 979,480
Typewriting machine, C. B. Yaw 979,630
Typewriting machine, W. W. Hopkins 979,671
Typewriting machine, D. Marinsky 979,680
Typewriting machine, H. H. Steele 979,717
Typewriting machine, W. J. Baron 979,731
Typewriting machine, W. J. Roche 979,800
Typewriting machine, L. Ney 979,991
Typewriting machine, C. F. Crandall, reissue 13,185
Umbrellas and parasols, notch or runner head for, J. B. Riehl 979,561
Vacuum apparatus, E. P. Noyes 979,788
Vacuum supporting device, J. E. Corbin 979,436
Valve, Merrill & Nicholls 979,532
Valve, A. B. Wallem 979,811
Valve, F. Messmer, Jr. 979,874
Valve arrangement for controlling fluid transmission gears, H. Lentz 980,100
Valve controlling device, J. H. Venn 979,725
Valve disk cutting machine, Smith & Williams 980,019
Valve for fluid pressure brakes and signals, conductor's, C. C. Farmer 979,837
Valve operating mechanism for use in internal combustion engines, G. Green... 979,943
Valve, radiator drain, C. C. Peck 979,553
Valves, device for preventing ignition of pressure admitting, J. H. & A. B. Drager 979,936
Vault light, J. J. Lawler 979,772
Vehicle, R. C. Sayer 979,572
Vehicle indicator, M. A. Martin 979,526
Vehicle pneumatic cushion, G. J. Bancroft.. 980,138
Vehicle shock absorber, C. G. Pulleys 979,694
Vehicle spindles, babbitting worn, J. L. Cramer 980,071
Vehicle supporting means, B. J. Diptock 979,447
Vehicle tops, front fastening device for, A. H. Smith 979,893
Vehicles, resilient apparatus for, C. G. Polleys 979,695
Vehicles, spring fork for wheel, Kittle & Gates 979,674
Velocipede, F. A. Gagnon 980,092
Vending apparatus, M. P. Henvis 979,854
Vending machine, E. E. Sullivan 979,586
Vending machine, W. R. Williams 979,625
Vending machine, R. F. Downey 979,833
Ventilator, E. W. Woods 979,728
Vessel fender, M. Moranucky 979,539
Vessels, flexible corrugated metal wall for collapsible and expansible, W. M. Fulton 979,460
Wagon box, adjustable, A. E. Sutherland... 979,722
Wagon brake, E. G. Doland 980,076
Wagon, dumping, J. Heberling 979,488
Wagon loader, A. McKinney 980,115
Wagon top, F. Geiger 979,839
Wall tie, partition, T. P. Shean 980,132
Washer. See coal washer.
Washing machine, S. E. Beelman 979,733
Watch movements, tool for removing the rollers of balance wheel staffs in, A. F. Robbins 979,562
Water cooler, Cram & Claridge 979,440
Water heater, B. A. Geurink 980,095
Water meter, W. H. Larrabee 979,518
Weather strip, F. A. Yeager 979,631
Weeding machine, J. H. Atkins 979,407
Weir and the like, F. Schnapp 979,574
Welding, electric, L. S. Lachman 979,970
Well drilling machine attachment, G. Homburg 979,954
Well pick up, oil, H. Sills 980,018
Well screen, H. R. Decker 979,748
Wheel, F. L. White 979,816
Wheels, making, A. Thompson 980,022
Winding cones and tubes, machine for, J. C. Coram 980,069
Windlass, W. A. Samuell 979,710
Windmill, W. P. Brett 980,172
Window bead fastener and the like, Church & Cowden 979,430
Window frame, F. Schneider 979,576
Wire fabric making machine, A. L. Kitselman 980,104
Wire stretcher, J. W. Baggett 979,915
Wiring device, portable, J. J. Kray 979,514
Wood, treating, F. J. Taylor 979,902
Woodworking machine, A. D. Catlin 979,824
Wrappers from strips, mechanism for cutting, H. C. Armstrong 979,406
Wrench, A. E. Smiley 979,805
Writing implement, A. H. Grantham 979,843

A printed copy of the specification and drawing of any patent in the foregoing list, or any patent in print issued since October 4th, 1859, will be furnished from this office for 10 cents, provided the name and number of the patent desired and the date be given. Address Munn & Co., Inc., 361 Broadway, New York.

Canadian patents may now be obtained by the inventors for any of the inventions named in the foregoing list. For terms and further particulars address Munn & Co., Inc., 361 Broadway, New York.

Aeronautical Notes

Louis Bleriot says high speed is dangerous, and suggests a parachute "life saver" for aviators.

Le Journal has fixed June 4th, 1911, for the start of its circuit, Paris-Berlin-Brussels-London-Paris.

The newest Zeppelin, "No. IX.," is very nearly finished. It is only 330 feet long, as compared to the 490-foot "No. VIII.," and the 420-foot "No. VII."

Throughout France in retrospect of the year's progress, the words of Wilbur Wright at Auvours in 1908 are recalled: "These Frenchmen fly like hens chased by a dog."

The French monoplane constructors are beginning to realize the importance of building their machines so that the pilot can have a clear view on all sides, and especially under him.

The Wright machine of Count de Lambert, which was recently fitted with a 50-horse-power Gnome engine, has been making excellent flights at a higher speed than the "stock" Wright.

Many of the foreign aviators who fly Blériot monoplanes have two sets of wings for the same body; one for lifting is large and quite curved, while the other for racing is much smaller and very flat.

The "reefable-surface" aeroplane, which many experts consider one of the greatest developments we may in future expect, seems already to be an actuality in France; the Delabrosse and Christolet monoplane is so constructed that the outer sections of the planes fold back, and reduce the speed from 29.7 feet to 23.1 feet.

The Parseval hydro-aeroplane has created a great deal of interest abroad. On October 15th it flew about three miles over Lake Plau at Mecklenburg, and when landing upon the surface of the lake was slightly damaged.

Up to the 1st of December the winnings of Frenchmen in aeroplaning totaled three and one-half million francs, Paulhan leading with 410,862 ($79,296), and Morane and Latham following him with about 260,000 ($50,180) each.

The Astra concern are busy on two new dirigibles for the French army. They are to be named the "Adjutant Reaux" and the "Lieut. Chauré." They are each fitted with two Pipe 4-cylinder, 110-horse-power motors driving three propellers, one at the [illegible] other two on either side above the nacelle, amidships.

There are many new types of monoplanes in France, noticeably the Sommer, the Morane-Saulnier, and the Minima. The Morane monoplane greatly resembles the Blériot XI. *bis*; it has a span of 32 feet, weighs 400 pounds, and uses a 50-horse-power Gnome motor. The Minima, built by the Société des Vehicules Aerien, weighs only 120 pounds without the motor, and has a spread of but 20 feet. A 15-horse-power Anzani motor is employed.

Trade Notes and Formulæ

Wax Ink for Zincography.—Carefully melt over a coal fire 3 parts of Syrian asphalt, 1 part wax, 1 part ceresine, 1 part colophony, 2 parts American rosin; take the mixture from the fire and mix in 20 parts of oil of turpentine, stirring in the meantime. To be kept in well stopped bottles.

Pipe Covering.—1.5 parts syrup, 2.5 parts rye flour, 10 parts loam, 5 parts cows hair, 50 parts fossil meal (kilselguhr), and sufficient water. Over the strata applied layers of fabric are laid, which are coated ¼ of an inch (5 millimeters) thick with a mixture of tar and lime (100 parts hot tar), into which is stirred 15 to 30 parts of slaked, sifted lime powder.

Preparation of Wax Powder.—Yellow bees wax is cut into very fine shavings and protected from dust, and dried at ordinary room temperature for 10 to 14 days. The wax must then be mixed in a mortar, having a rough surface, with an equal quantity by weight of rice starch. The mixing is effected at the lowest possible temperature without rubbing. The powder mixture is finally passed through a fine tin strainer.

Insulating Covering for Steam Pipes (according to Dietrich).—The cleansed pipes are coated with a priming coat consisting of 200 parts liquid water-glass, 100 parts of water, 150 parts fine sand and 30 parts sifted sawdust. The covering mixture comes next; 60 parts of dry loam, 8 parts sifted sawdust, 3 parts ground cork refuse, 4 parts potato starch, 4 parts potato dextrin, 4 parts powdered water-glass, 30 parts of water. The loam must be well kneaded up with the water and add to this the previously mixed pulverized substances. The paste-like mass is then spread with a trowel on the heated and primed metal surfaces, to a thickness of 3/16 to 5/8 of an inch (5 to 10 millimeters). When this layer is thoroughly dry, the top coating can be repeated, until the pipe covering has a total thickness of at least two inches (20 millimeters). Previous layers must always be allowed to dry thoroughly. To give a smooth finish to the final coat it must be brushed over with water, while still wet.

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